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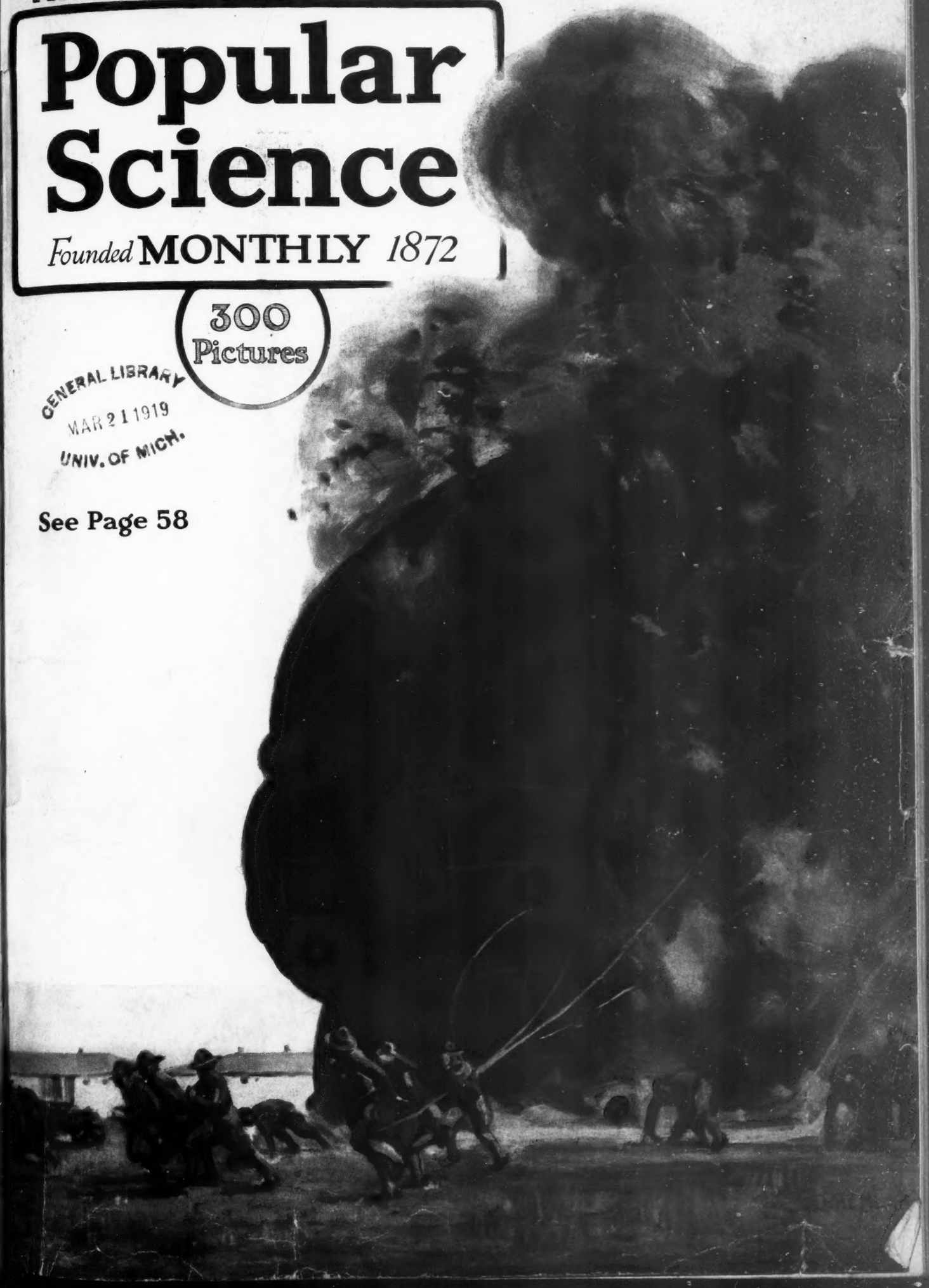

It's toasted

On the way down town

After a baked apple for breakfast! Wasn't it good? Tastes better than a raw apple—more flavor. Now — as you light it — notice the delicious "cooked" flavor of your

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It's toasted. Like the apple, it tastes much better "cooked" than "raw" because -

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What We Don't Know About Volcanoes

Also a few things we do know—notably about the tides in the solid earth and in lakes of lava

By Calvin Frazer

LET us be honest and confess that what we do not know about volcanoes will, a hundred years hence, fill a good-sized library.

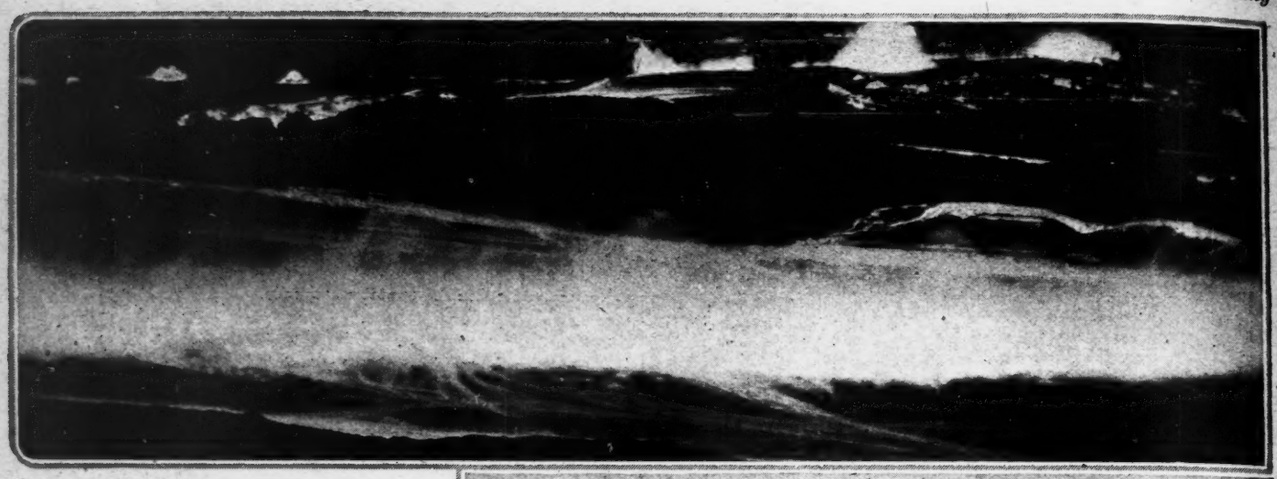
Volcanology is in the making. For that very reason it is all the more fascinating. A young man who wishes to make a name for himself (and little or no money) could hardly choose a more promising career than that of volcanologist, provided he has an aptitude for scientific research, the physique to endure rough mountaineering, and the courage to face the risk of being engulfed in fiery lava or buried under a shower of red-hot rocks. There are plenty of brilliant discoveries to be made, and the field is not a bit crowded.

Our grandfathers knew a great deal more about volcanoes than we do, but what they knew was nearly all wrong. They declared that the interior of the globe was a "molten mass." It is, almost certainly, a dense solid, more rigid than steel.

How do we know? By several facts—

Long before war made them famous, gas-masks were faithful friends to students of volcanoes. These masked experts, working on the temporary crust of a hot lava lake, are collecting samples of gases

Photograph by Dr. A. L. Day



Photograph by de Vis-Norton

The weird beauty of the lava as seen at night when waves of living fire break against the mountain crags

its weight (as determined by astronomers), the way it transmits earthquake waves, the resistance it offers to the distorting effect of the sun's and the moon's attraction, etc. But the interior of the earth, as far as we can determine, is so intensely hot that if at any place far below the surface the stupendous crushing force of the rocks above is, by any means, somewhat reduced, the solid must change to a liquid or even a gas.

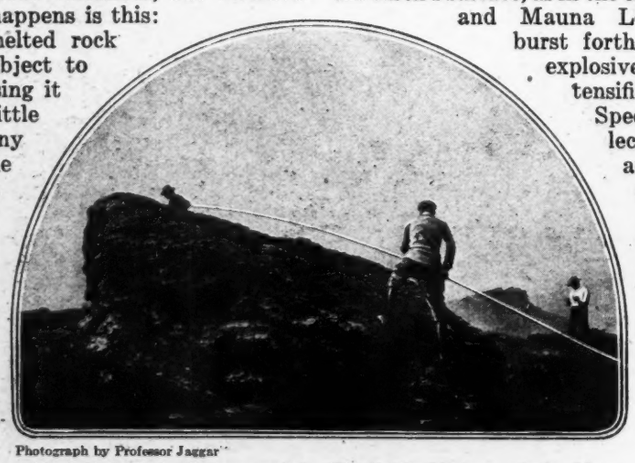
Earth Tides Cause Eruptions

Various circumstances do, in fact, bring about an easing up of this pressure, here and there and from time to time. The whole globe is shrinking as it cools, and its surface is warped into folds and creases. Moreover, there are regular tides in the earth's crust—a rise and fall of about a foot, on an average, twice a day. These things cause variations in pressure underneath, and the melting of deep-seated rocks probably takes place on a vast scale. It is only occasionally, however, that a little of the liquid rock, known as *magma*, rises to the surface and gives us a volcanic eruption.

How does the magma get to the surface? That is one of the things we do not know about volcanoes, but we have a strong suspicion that what happens is this: Imagine a large mass of melted rock miles underground. It is subject to tidal and other stresses, pressing it this way and that. In the brittle crust of the earth there are many fissures, through which the magma will be squeezed out as far as possible. Suppose one of these fissures, directed upward, to be nearly filled with the magma. Through the magma stream gases, generated from the more volatile elements of the rocks, and these gases accumulate at the top of the column, where they are under such great pressure that they become excessively hot, according to a well known law of physics. It is probably this hot gas which, by melting the adjacent rock, eats its way through the strata, forming a vent for the magma. The liquid rock may come forth in a quiet flow at the earth's surface, as in the case of the volcanoes of Kilauea and Mauna Loa, in Hawaii, or it may burst forth in a great explosion. The explosive effect is probably much intensified by the presence of steam. Specimens of volcanic gas collected in the crater of Kilauea and pumped from the lava into collecting-tubes, without coming in contact with the air, were found to be heavily charged with steam.

Photograph by Professor Jaggar

Just before the overflow of the lava lake of Kilauea emerging from the lake, which is flowing rapidly from right to



Photograph by Professor Jaggar

Professor T. A. Jaggar and L. W. de Vis-Norton, of the Hawaiian Volcano Research Association, taking lava temperatures

Lakes of Lava with Tides

It is easy to see that if a narrow vertical channel is connected with a large subterranean reservoir completely filled with liquid rock, a small amount of

Photograph by Professor Jaggar

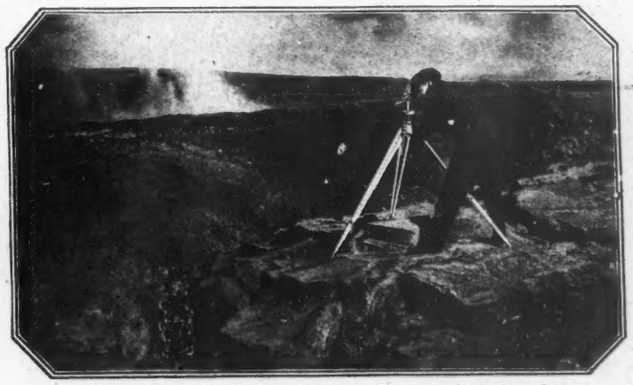
Looking out over the lava lake. The foreground is composed of lava less than an hour old, already breaking up

volcano. The crags are the head of the main lava column left in the picture, while a small fountain is playing at the right

pressure on the latter will cause a rapid rise of the liquid in the channel.

Apparently we have a case of this kind in the Hawaiian volcano of Kilauea, with its remarkable lava pit of Halemaumau. This pit is a small crater within the big one, and it contains a lake of lava, which rises and falls from day to day. Sometimes its surface is hundreds of feet below the summit of the pit, while at other times it rises quite to the top and overflows.

For some years past daily measurements of the level of this lava have been made with surveying instruments by the staff of the Hawaiian Volcano Observatory, under Dr. T. A. Jaggar; and one of the most interesting of volcanological discoveries is that the lava lake exhibits very pronounced tides, depending upon the relative positions of the earth, the sun, and the moon. The lava is highest in summer and winter and lowest in spring and autumn; and there are minor oscillations twice a day and twice a month. Dr. Jaggar believes that the intermittent lava flows, on a much larger scale, from the neighboring crater of Mauna Loa, are also due to tidal forces, and he justified this belief by predicting, some years in advance, the eruption of that volcano in 1916.



Photograph by Professor Jaggar

Surveying the lava lake, 200 feet below the observer. The usual method of reaching it is by rope ladders

Can Eruptions Be Predicted?

Can the eruptions of other volcanoes be predicted? If so, then volcanology is one of the most important of the sciences in terms of human welfare. This practical problem is not yet fully solved, but it is in process of solution. A sudden succession of earthquakes at a volcano portends an eruption, and the few volcano observatories of the world are all equipped with seismographs — instruments that record the slightest earth tremor. When an eruption is in progress the chemical composition of the volcanic ash gives some indication as to how long the eruption will last.

That our lamentable ignorance on the subject of volcanoes is gradually giving place to valuable knowledge is due to a small number of investigators, some of the most brilliant of whom are Americans. The foremost volcanologists of the world today are the Americans Jaggar and Perret, and their field work has been admirably supplemented by the researches of the Carnegie Geophysical Laboratory, in Washington, under Dr. A. L. Day.

Shortly before the European war began, an international institution of volcanology was established at Naples by Immanuel Friedlaender. It is now temporarily located at Schaffhausen, Switzerland.

The leading volcanological observatories are the one on Kilauea, maintained by the Hawaiian Volcano Research Association, and one on Vesuvius.

A Gigantic Rock of Ages

PERHAPS the hand of man has never carved out another single stone as large as this. It is 68 feet long and 14 feet square, and weighs 1,200 tons. Huge monoliths from the same quarry where the giant reposes are found in the stupendous ruins at Baalbek, Turkey, where 4,000 years or more ago a wonderful race of builders erected the temple which men today call the "Trilithon," after the great stone in the wall. The stones that were transported from the quarry are only a little smaller than their titanic brother, being 63 feet long and 13 feet square.

Labor was cheap and plenty in those early days; but, even so, engineers of today marvel at the ingenuity and resource of the builders, who by hand-power and inclined planes drew the monsters from the quarry bed, transported them to the site of the temple, and swung them into their appointed places.

The Ferry Is the Ferryman's Back

IF you wished to cross the Sutley river in India, you would have the choice of swimming across or of riding on an Indian ferry. If you chose the latter, you would be offered ferry space either sitting on or lying across the back of a native, who in turn would be lying across an inflated bullock-skin with his legs trailing behind in the water. The ferryman inflates the bullock-skin by blowing it up through a hole in one of the legs. After you had climbed on the Indian's back he would push out from the shore and paddle his way across, kicking strongly. If you shifted your position while en route you would most likely topple off. In fact you might topple off without shifting.

Without a doubt, this original ferry is as clumsy, far-fetched, and dangerous as possible. The only sensible reason for its existence is that the natives had entirely too many bullock-skins.

His Barómeter on His Knee

WHEN an aviator wants to know whether he is getting up in the world, he consults an instrument of the barometer species. Barometers, as you know, measure the weight of pressure of the atmosphere.

An air pilot hasn't much space in which to store the tools of his craft, and so Lieutenant Giuliano Parvis wears his barometer—a big brother of the wrist-watch—where it will be constantly under his eye when he is seated in his airplane.

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French Idea of a Hun Hat-Rack

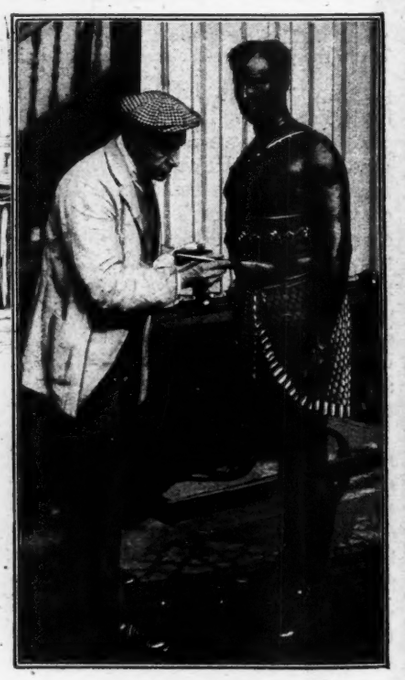
THERE are more important things to be done in France today than disrobing statues of their war-time sand-bag protection. Since the statues must remain ugly for a while, the French trimmed some of them up with an over-supply of German helmets which they had on hand.

Not as Black as He's Painted

THIS fellow deserves infinite praise for standing stoically while an artist tickles his ribs with a paint-brush. Moreover, he is being painted with shoe-blacking, which may or may not wash off. But an Ethiopian was badly needed in the movie studio, and the only way to get one quickly was to manufacture him.

For the sake of the silent drama—and a good day's pay—this six-footer volunteered. Half finished, he gives promise of making an excellent "black."

Perhaps, after all, movie stars earn their fabulous salaries.



A German Family-Portrait Propeller Watch

AN enterprising aviator has combined the German passion for family portraits with an airplane propeller in the clock shown below. The propeller is the frame in which the works reside, and the hours are marked by relatives. This clock is not only ornamentally excellent, but is also very useful to the busy housewife pickling pickles in the kitchen. Too busy to stop her work in order to find out the time, she calls to her young son in the living-room: "Wie viel Uhr ist es?" (What time is it?), and he promptly replies: "Onkel Fritz nach Bruder Hans" (Uncle Fritz after Brother Hans). Mother interprets this as twenty-five minutes past eight, and continues her pickling.

Ten Empty Cartridges Make One Swagger-Stick

VERY soon, now, people will appear on the streets dressed up in war implements which the boys have brought back.

Anticipating this, a thrifty artificer from Michigan gathered unto him many empty cartridges. He soldered together nine or ten of these "empties," polished them up, smoothed over the rough places, and called the result a swagger-stick.

Dainty ladies who like to swing such sticks will find that these dead ones are still quite powerful if swung with sufficient force.

This making new things out of old things would seem to indicate that the thrift born of the Great War will continue to live for many years.

Almost Human Intelligence

NINE car-loads of coal, or about three thousand tons, can be handled in one day by this elevator, which also screens and cleans the fuel at the same time.

In operating this elevator, the coal is dumped into a hopper, carried to the top of the structure by an endless chain, and distributed according to size into three bins.

Five trucks can load at one time from the elevator, which is built of steel and is considered a model of its kind.

Peace or War—Ham or Turnips?

HAM and turnips together make a palatable dish, but if choice of one alone were given us we would elect ham. No choice was given the German people; and so, after they had turniped for three long war years, they ventured to become displeased with the powers that made things so. The bravest of them, residents of Niederlahnstein, voiced a silent protest in the bill below.

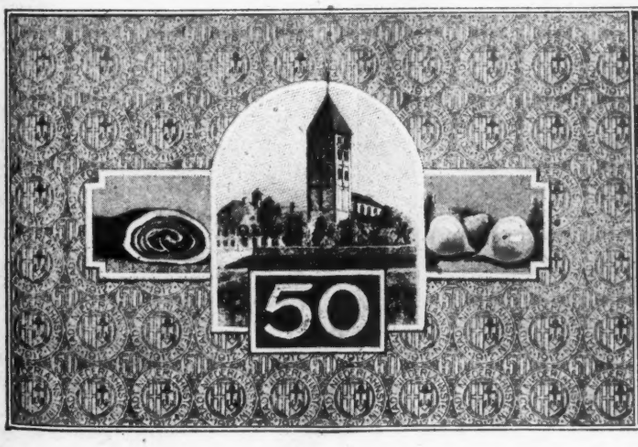
In the center stands the town hall, on its left a ham, and on its right three turnips. All the little circles around the central group bear the name of the town and the date 1917, except those two directly above the meat and vegetables. The one above the ham, translated, reads: "Tender longings, sweet hopes"; and that above the turnips: "How we live, 1917."

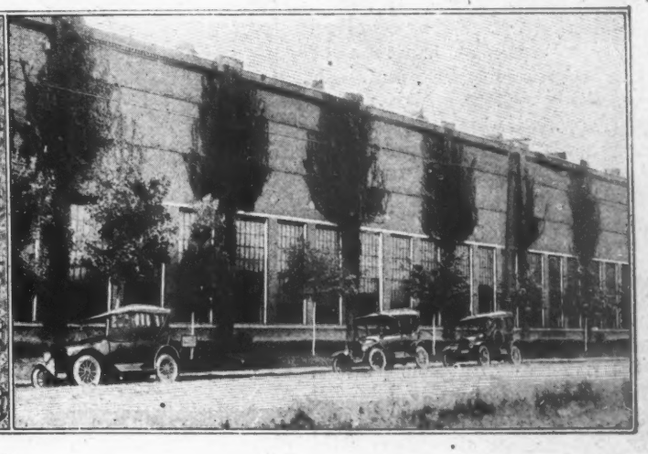
And Trees All in a Row

SEE the pretty trees growing alongside of the building in the picture below? Well, look again, and you will see that they are not trees at all.

This striking bit of scenery is on the side of a large munitions plant in a Cincinnati suburb, and is attracting the attention of thousands of people.

Early last spring the owners of the munitions plant, wishing to hide the brick walls of the building, planted Boston ivy at intervals along the base of the walls. The ivy grew rapidly and soon crowded the spaces between the windows. When the plants reached the top of the windows they found room to spread in both directions, and they soon shaped themselves into trees growing on the brick walls.

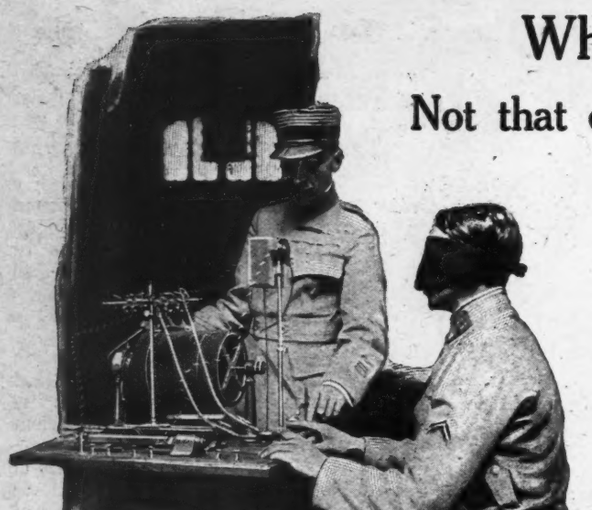




What's Your Speed?

Not that of your car, but of your brain?

By Ernest Welleck



How promptly will the blindfolded soldier respond to a touch? It depends upon his brain speed

HOW promptly does your brain respond to impressions by muscular reaction? If you don't know, and the chances are you don't, go to Dr. Amar, in Paris, and let him find out for you. He will submit you to a few psychographic tests, and at their conclusion will tell you your speed to the hundredth part of a second. Incidentally, he will tell you whether you are fitted for the profession or occupation in which you are engaged or intend to become engaged.

His Own Invention

The apparatus that Dr. Amar uses is a psychograph of his own invention, a device for registering the promptness, intensity, duration, etc., of muscular responses to impressions received by eye, ear, or sense of touch of the person tested. The apparatus has a cylinder covered with paper coated with lampblack.

This cylinder is revolved by clockwork at the rate of one revolution a second. A vibrating needle, which makes one hundred double vibrations a second, marks a wavy line that serves as time measure for minute fractions of a second upon the blackened paper. The muscular reactions of the subject tested are transmitted by air-pressure to two needles, which mark a record of these reactions on the cylinder.

Dr. Amar will seat you in front of a table equipped with the testing apparatus. Directly before you are two little pneumatic drums. When you have received your instructions, you place a finger upon the membrane of one of the little drums, your eyes focused on something that resembles a small camera.

A few minutes later a touch of the Doctor's finger upon the shutter releases allows a flash of the electric light in the box behind the lens to reach your eye. At the same moment—so it seems to you—you press your finger upon the drum-head. The air-pressure in the drum simultaneously causes a needle to mark a line, more or less curved, on the lampblack-covered paper.

You Read Your Record

Then the paper is taken off the cylinder. Here is the mark of the Doctor's signal and there is the record of your reaction. The Doctor counts the number of waves of the vibrating needle on the paper, and informs you that 20/100 of a second elapsed between the signal and your response. And you imagined your pressure to have been simultaneous with the signal!

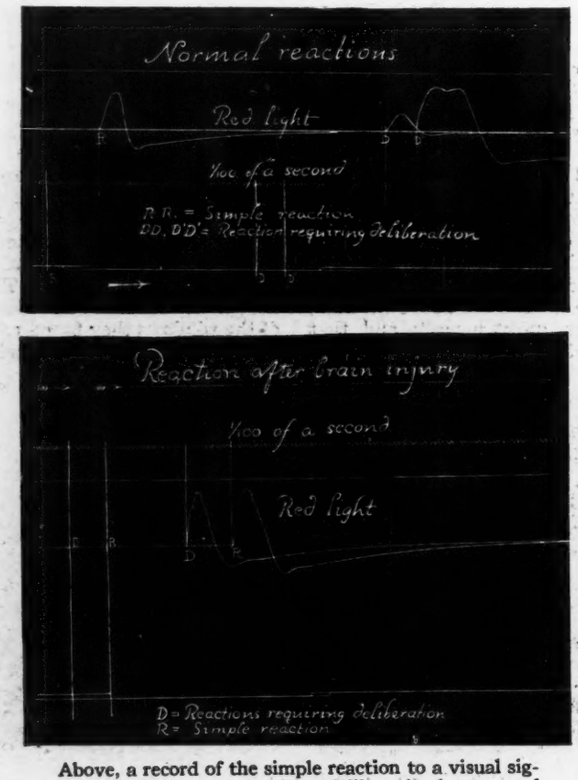
You are assured that your brain functions normally—that the time for simple visual reactions in normal subjects averages between 0.195 and 0.21 seconds.

Tests that Involve Deliberation

In the tests for reactions involving deliberation, the same device is used. You place one finger of the left hand on one of the little drums, one finger of the right hand on the other drum. You are informed that the left drum means blue, the right drum red. The Doctor flashes a red or a blue light through the lens of the camera-like device, and you signal back the impression by pressing the right or the left drum-head. On examining the record on the cylinder, you find that it took you more than twice as long to react in this visual test as in the simple visual test in which you were not called upon to decide whether the light was red or blue.

From hundreds of observations like these Professor Amar has drawn interesting and valuable conclusions which enabled him to determine the aptitude of the individual tested for certain vocations, a problem of importance in finding employment for the thousands of soldiers returning from the war.

The statistical material so far collected shows that the age of the subject, between the limits of eighteen and forty-five years, does not materially affect the time of simple reactions. Subjects whose occupation demands alertness—for instance, designers, typists, and mechanics—react more promptly than farmers, who are invariably slower by 0.02 seconds or more. The records of persons who have sustained injuries of the brain, or who have been operated on because of such injuries, show much higher figures: 0.32 seconds for visual signals, 0.24 for sound signals, and 0.21 seconds for touch signals represent the average for that class of invalids.



Above, a record of the simple reaction to a visual signal and of reactions requiring deliberation by a normal person; and, below, a record of similar tests on a young coppersmith whose brain has been injured

With This Saw One Man Does the Work of Two

IN building docks, trestles, piers, and similar structures, it is often necessary to cut piles, stringers, and other timber after they have been put in place. Frequently the sawing has to be done in places difficult to reach, and under conditions that make the handling of the saw extremely awkward. It required at least two men to do the work with the old-fashioned cross-cut saw, and it was slow work at the best.

The recent invention of a cross-cut saw which can be operated by one man is of considerable importance and value, especially at the present time, when laborers are scarce. This device consists of a light steel frame which is clamped in position against the tree, pile, or post to be sawed. The saw-blade, which is pressed in contact with the wood by a spring, is attached to a slidable rod which is moved back and forth by an upright lever worked by hand.

See how neatly this saw cuts the piles flush with the cross-timbers of the pier

The mechanism is extremely simple and cannot easily get out of order.

The method of operating this saw makes it possible to use it in places and under conditions that would preclude the use of the old-style saw. Trees may be sawed close to the ground, which means an appreciable saving of lumber.

Piles may be cut flush with the cross-timbers of a dock or pier, and in the case of necessity it is even possible to saw piles under water with this saw.

The saw can be adjusted as to pressure and length of stroke, and one man can do twice the work that two men can accomplish in the same time with one of the old-fashioned cross-cut saws.

Making the Farmer's Car Earn Its Cost and Keep

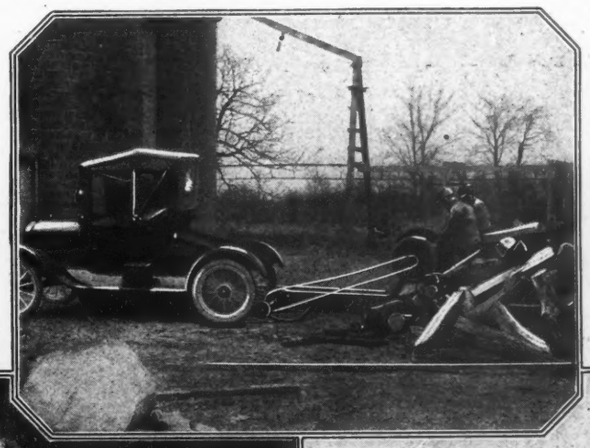
"SHE'S running fine," remarks the farmer to his foreman, pointing with satisfaction to his automobile, in which he has just returned from a trip.

"That's good," answers the foreman, "because there's a lot to do today."

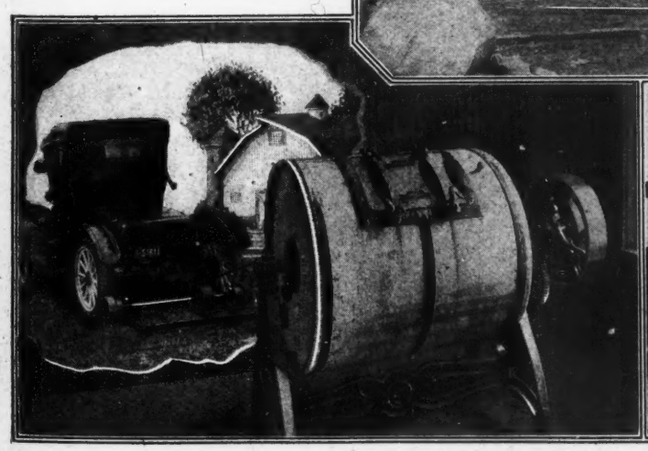
"What's the program for today?" inquires the farmer.

"Well, first we have to saw about fifty fence-posts for that new pasture; then there are about a hundred bushels of corn to shell and some feed to grind, and if there is time we ought to pump a little more water in the tank. And we mustn't forget to make the butter that is to go to market in the morning."

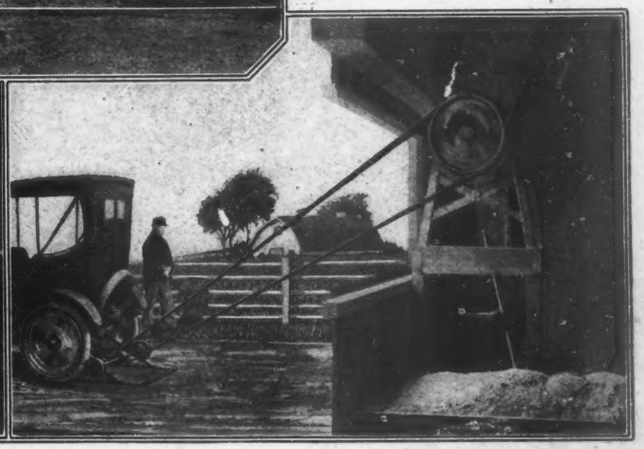
The circular saw is stationed near the wood-shed, and the lumber is piled up by its side. The farmer backs his automobile up a short distance from the saw. The foreman pushes an iron framework with a cross-shaft of steel, having a fixed pulley at each end and a movable pulley in the middle, under the rear axle of the automobile. Then he pushes down the cross-bar of the tilted frame. This lifts the rear wheels off the ground, and when the cross-bar reaches the ground the rear axle of the car slides down the inclined brace of the frame, until the tires of the rear wheels come to rest against the two eight-inch drive pulleys at the ends of the shaft. The drive belt of the circular saw is slung around the pulley in the middle of the shaft, the proper adjustment is made, and a few minutes later the buzz-saw, driven by the car wheels, is cutting through the logs.



And so the corn was shelled, the water pumped, and the butter churned, all with the help of the automobile.



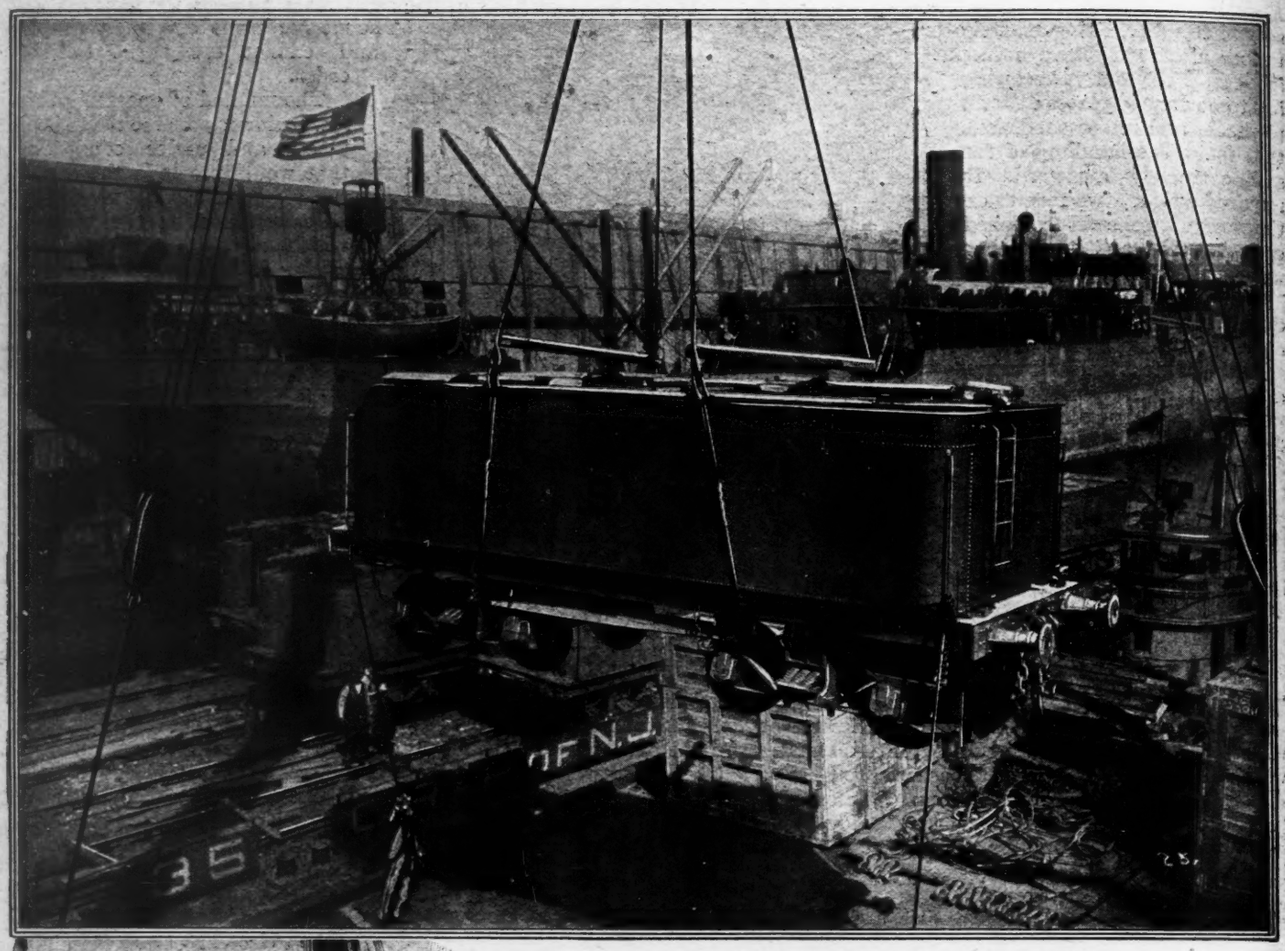
Turning the heavy churn is mere play for your automobile, if its power is transmitted by this pulley frame



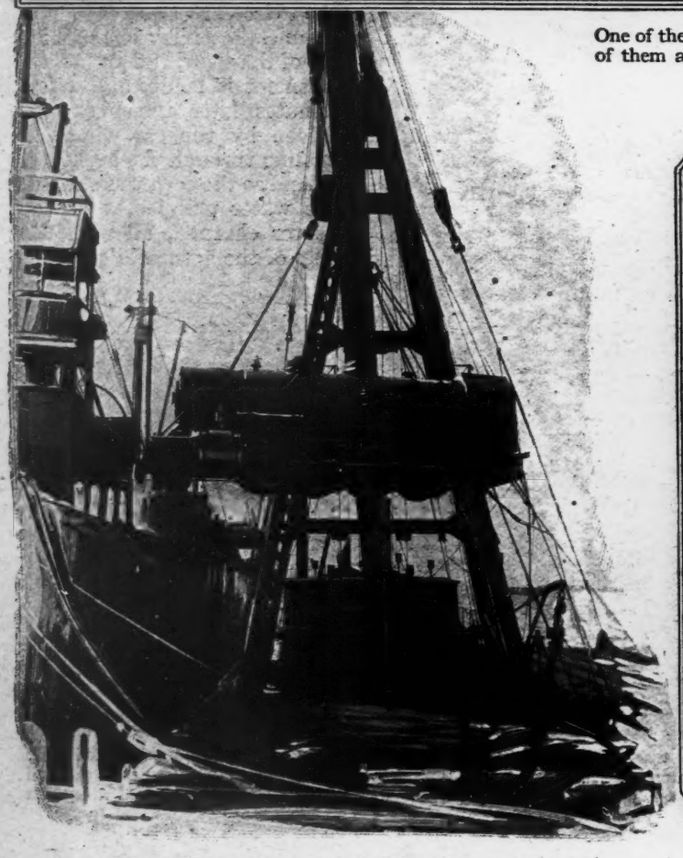
With the help of this transmitting device (*upper picture*) and a buzz-saw, your automobile will cut twenty cords of wood on three gallons of gasoline

In an idle hour your automobile will grind out a big pile of feed without requiring special attention

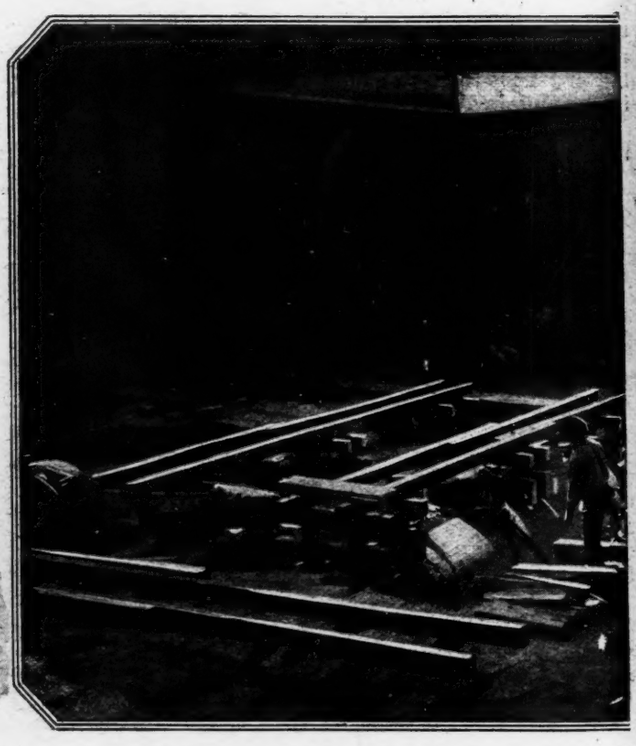
How We Transported Whole Railroads



One of the huge tenders being hoisted on shipboard. Fifty of them and a like number of engines make a full cargo

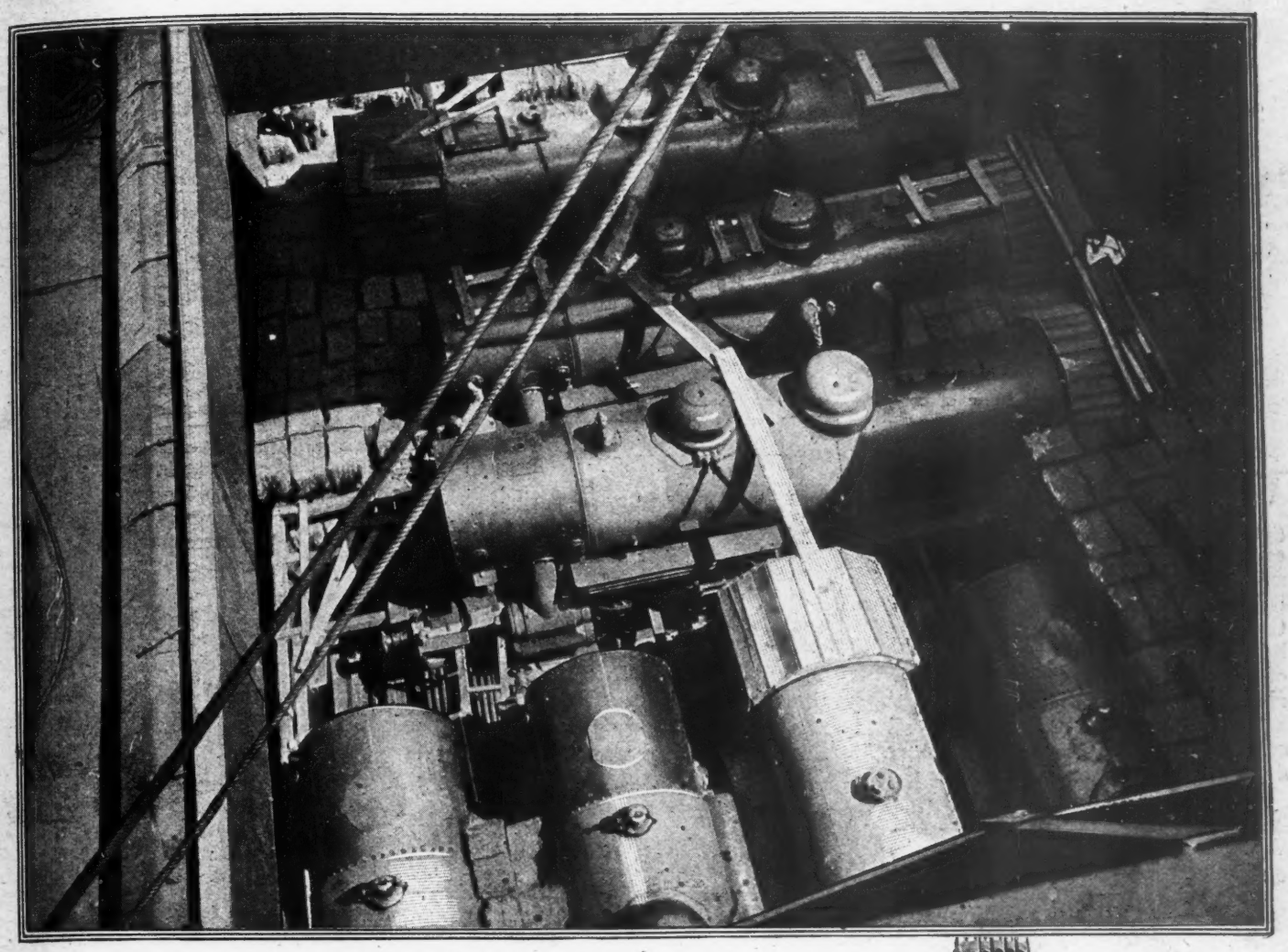


Huge A-frame derricks handled the heavy engines and tenders as easily as if they were mere toys



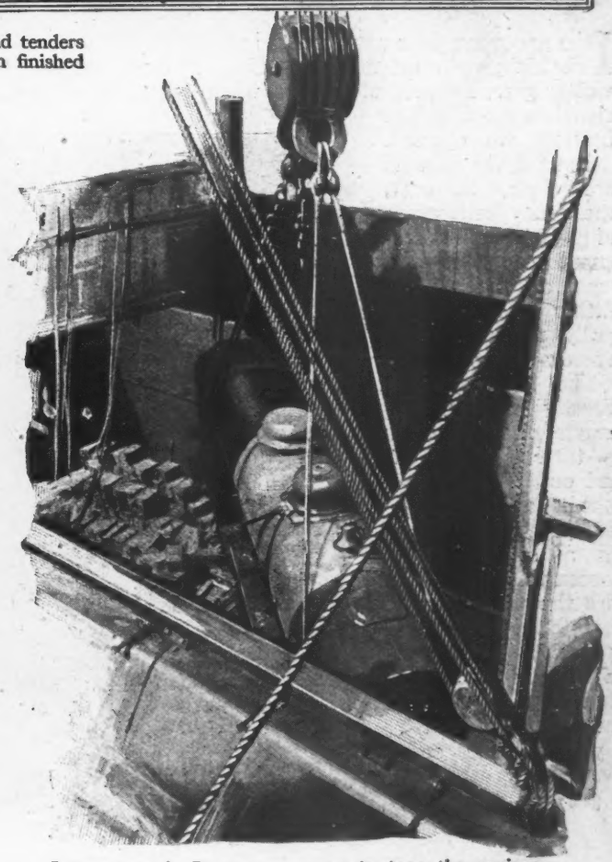
As they looked stowed in the hold. Great quanti- engines would nest softly. Not a wisp was wasted,

Across the Seas to Distant France



Looking down into the hold of a ship loading with engines and tenders bound for France. Below you see how the job looks when finished

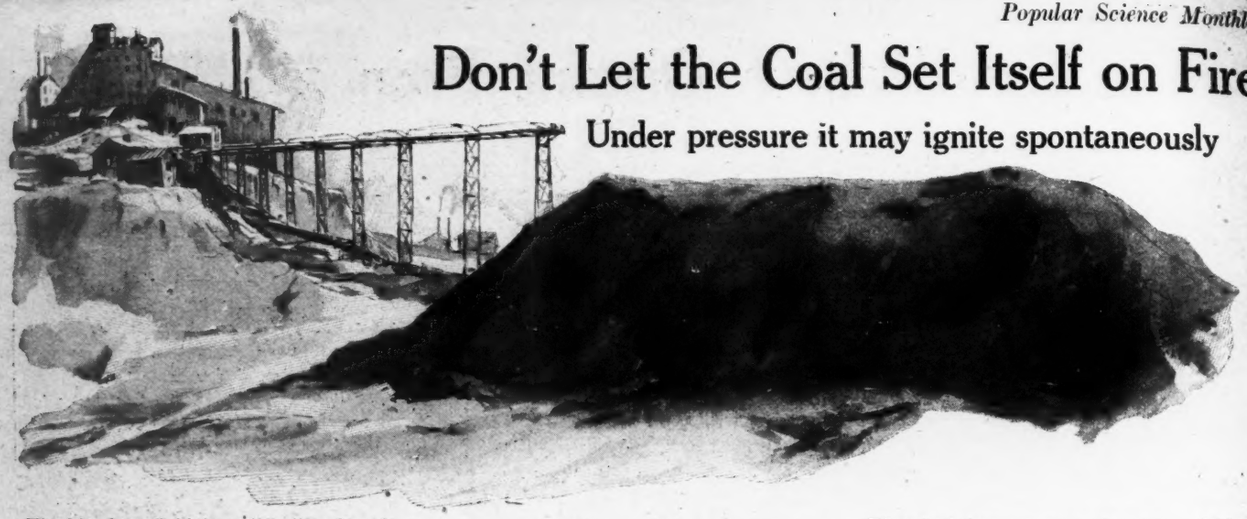
ties of hay were used in the packing, so that the as our cavalry and artillery horses can testify



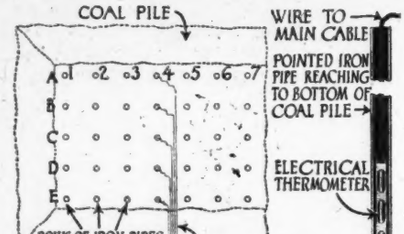
Lower away! It was necessary to turn the engines diagonally across the hatch-opening to get through

Don't Let the Coal Set Itself on Fire

Under pressure it may ignite spontaneously



The bigger and higher the pile of coal, the greater will be the danger of spontaneous ignition in the interior of the mass



Electrical thermometers placed in vertical tubes driven into the coal-pile at regular intervals will give warning of danger

WHEN coal is stored in large quantities there is always danger of its becoming ignited spontaneously. The larger the quantity of coal stored, the greater the possibility of its catching fire. The higher the pile, the greater the pressure by the overlying mass on the coal near the bottom of the pile, and the more thorough the exclusion of air from its interior.

The organic matter of which all coal consists is constantly undergoing a process of slow oxidation. On the surface, in the absence of pressure, and with unrestricted circulation of air, the heat set free by this chemical reaction does not rise to the ignition point of coal. But under pressure the temperature steadily rises until it reaches the ignition point of coal and combustion begins.

In some of the big yards, wrought-iron pipes are driven into the coal-pile at intervals. Electrical thermometers are placed in these pipes from time to time, and when the temperature reported from any point in the pile reaches the danger point, the coal at that point is thoroughly aired.

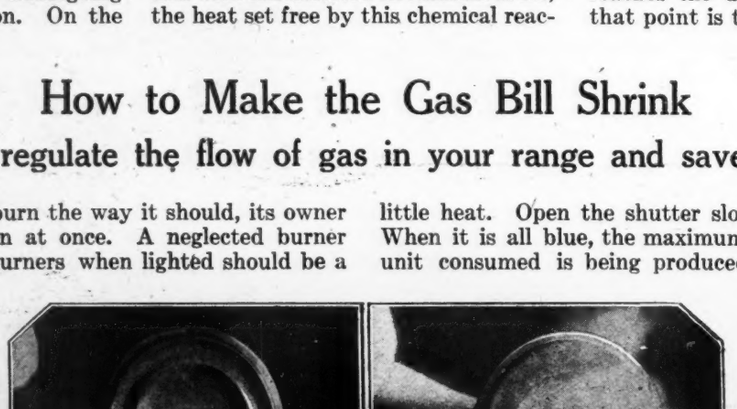
How to Make the Gas Bill Shrink

Learn to regulate the flow of gas in your range and save money

IF a gas-range does not burn the way it should, its owner should give it attention at once. A neglected burner wastes gas. Popping of burners when lighted should be a signal to see that the burners are cleaned.

Even if the burners are clean, however, there may be a waste of gas. The most frequent cause is too much or too little air. Either defect is very easily remedied with a screw-driver.

The air intake is directly behind the handle, or valve, used to turn the gas off and on. This air intake has a sliding shutter fastened in place by a small screw. Loosen this screw and turn the shutter until the intake is completely closed. Then turn on the gas and light the burner. You will find that it burns with a yellow flame, consuming a great deal of gas and producing little heat. Open the shutter slowly, watching the flame. When it is all blue, the maximum amount of heat per gas unit consumed is being produced. When the shutter is open to this place, tighten the screw so as to fasten the shutter firmly in place.



(*At right*) When the shutter has been adjusted to make the gas just right for the blue flame, the screw is tightened to keep the shutter in that position

(*Above*) With the flame high, most of the gas is wasted in evaporating the water. The other picture shows the flame as it should be with the water simmering

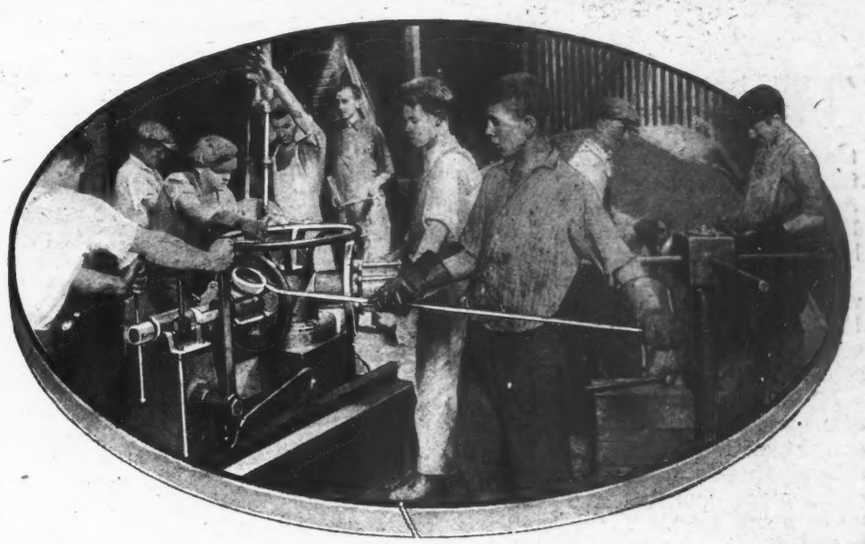
The commonest cause of wasted gas is the rapid boiling of foods. In boiling potatoes, for instance, the gas is usually turned on full force; yet the potatoes are cooked only a little more rapidly than if the gas were turned low so that the water barely simmered. In either case, the water is at the boiling temperature, and no higher.

By turning the gas low after the boiling stage is reached, the potatoes can be cooked almost as quickly as with the gas high, little water evaporated, and almost half the gas saved.

Making Piston-Rings by Whirling Them into Shape

And the speed is forty times greater

By E. F. Cone



One man pours the metal into the trough and another operates levers that control the casting

ONE of the many small manufactured products of which millions are used in the United States alone each year are piston-rings. They are thin round objects of cast-iron, made to fit in the cylindrical piston of all automobile and airplane engines. There are many used in steam, marine, and other engines, as well as in pumps. A conservative estimate has placed the number used in this country alone in one year at not less than 200,000,000. The Ford automobile plant uses about 16,000,000 yearly.

It has been customary, and still is in most plants, to make these rings the same as any other small iron casting is made—molding them in sand by means of a molding-machine. By this process about 420 rings a day can be made by each machine.

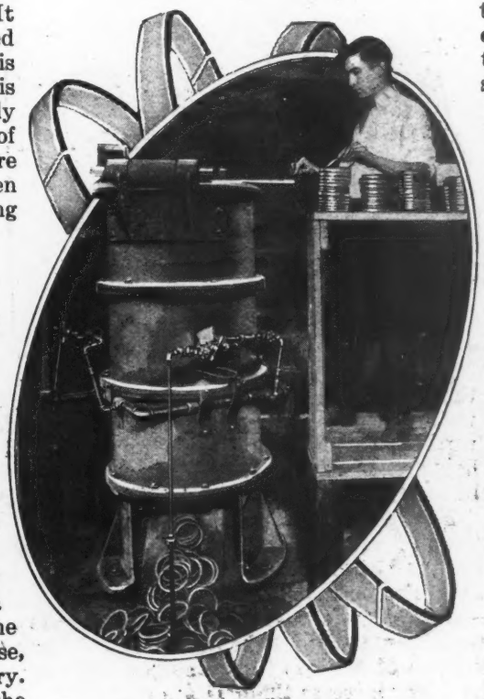
But a new process has been invented whereby the old way of making these rings is virtually revolutionized. It is called the de Lavaud process, named for the inventor, a Brazilian who is now a resident of New York. By this new process, rings are being made daily in one machine to the number of 18,000 or 20,000. The unusual feature of the process is that the hot molten iron is cast directly into its final ring shape by centrifugal motion.

A Very Simple Process

The process is very simple. It consists in introducing into a rapidly revolving iron mold a definite amount of hot metal of proper composition. This is immediately thrown to the outer surface of the revolving mold, where it quickly cools and assumes its definite shape in the grooves of the mold. It must then be annealed, or softened, for it is very hard, and afterward ground on a special machine, thus rendering the finished product nearly ready for use, only a little machining being necessary. An important consideration is that the rings are uniform in size and thickness of section.

The machine in which the rings are cast consists of three arms protruding from a central revolving standard. On each arm is placed a permanent mold in which the rings are cast. This is a series of alternating rings of cast-iron and of thin boiler-plate separating the rings, these forming a series of grooves, the size and thickness of the piston-ring to be made. By varying these, any diameter ring from 1½ to 8 inches can be made in this machine. By enlarging the machine, rings from 30 to 40 inches in diameter can be made.

These alternating pieces of metal are held together by an ingeniously arranged set of bolts and pins. A revolving wheel, operating by electricity at the bottom of one side of the central standard, is the motive power that causes the axle carrying the mold to assume its rapid motion. This has a momentum of 1,200 revolutions a minute when the ring is being cast.



He puts the rings into the annealing apparatus and they come out at the bottom softened

How the Rings Are Formed

A movement of the larger hand lever, shown in the picture above, quickly brings the revolving mold over the small trough in which the hot metal is poured. These troughs are replaceable at any moment, and are lined with a refractory. A rapid inversion of this trough while inside the revolving mold empties the metal into the grooves, thus forming the rings. A further slight movement of the lever brings the revolving mold against a brake, which stops the revolution. A reversal of the lever brings the mold back against the central standard. A turn of the machine carries the mold with its rings to the right, and brings a new mold ready for a new charge of metal.

The molds are transferred to the four arms of the pedestal situated at one side of the casting-machine. Here a crew of boys remove the bolts, allowing the rings to fall into baskets. The disassembled molds are kept intact loosely, and placed on the arms of a revolving wheel, by means of which they pass through a tank of cooling liquid. A new machine has nearly been completed for performing the disassembling by electricity.

This new process is unique. The product is not only practically ready for use, but is superior in every way. The metal has been proved to possess striking properties in the way of strength, elasticity, and uniformity, particularly as to its hardness.

Trapped in a Sunken Submarine

Tons of water pressed down on the hatch. How could he escape? Recollection of an old physics lesson saved him from death

By Joseph Brinker

THIS is the story of a restless English schoolboy who listened wearily as his teacher talked Boyle's Law and Archimedes' Principle. What was Boyle or the laws that gases and liquids under pressure obey to him?

The time came, ten years later, when they meant life or death to him. It happened during the war, when he was one of the crew of a British submarine.

His boat was lying idly on the surface of the water. All the officers and crew except himself were enjoying a holiday ashore. He went below to work in the engine-room, and left the conning-tower hatch open. Then something happened—the young man never knew just what—and the boat lurched down by the bow.

He thought of the conning-tower hatch, and rushed forward to close it. But the water was already pouring in with such force that he was unable to accomplish his purpose. He returned aft to the engine-room, and locked himself in by means of a water-tight door which separated the boat into two compartments.

In Complete Darkness

He was safe temporarily, but the other half of the boat was filling with water, and the submarine was sinking lower and lower.

The engine-room was in complete darkness, due to the short-circuiting of the electric system. Everything he touched shocked him.

The salt water on the storage batteries generated suffocating chlorine gas. He rushed blindly at the engine-room hatch and tried to force it open. But his strength was no match for the pressure of the water outside; and, even if he had been able to open it, he would have been no better off, for the water would have rushed in and drowned him before he could possibly get out.

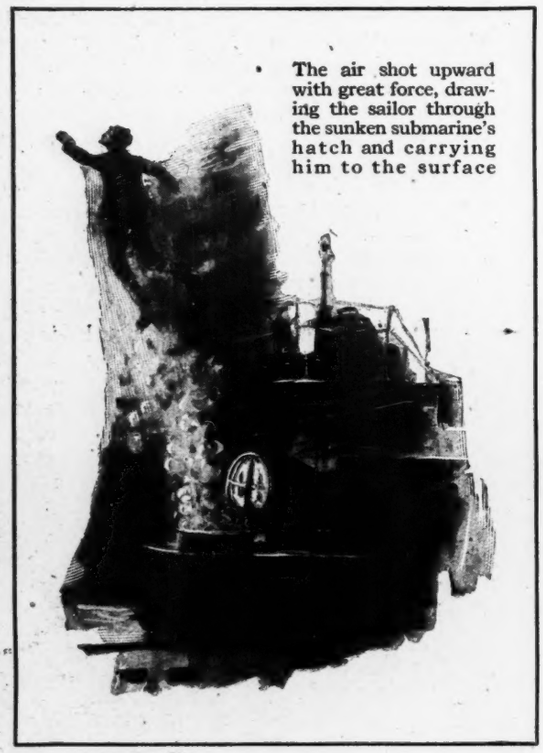
He Reviews His Past

Realizing that his last chance was gone, he grew quite calm, and, as is the custom of dying folk, reviewed the things he had done and those he ought not to have done while here on earth.

As he came to that day in school when he unwillingly learned of pressure, he stopped. Water, gas, pressure—what about them?

He Remembered That Lesson

Then he remembered that, in the case of a body submerged in water, the combined force of the gas within and the strength of the body material must equal the force of the water without, or the water would crush the body in. Just so the combined force of the air in the submarine and the steel of the hatch equaled the force of the water pressing down on it. If he could make the force of the air in the boat equal to the pressure of the water on the boat, then the hatch would be relieved of the strain of holding off the water, and would be easily lifted.



The air shot upward with great force, drawing the sailor through the sunken submarine's hatch and carrying him to the surface

How could he increase the force of the air? Then he thought of Boyle's Law, which he had been forced to memorize on that long-ago school-day—the volume of a gas varies inversely with its pressure. If he decreased the volume of the gas in the submarine, he might increase the pressure enough to make it equal that of the water. This done, the hatch would be in equilibrium and consequently easily moved.

His next problem was how to decrease the volume of the air. There was only one way to do this—by letting the water in. If he did that he would be taking a last desperate chance; for he did not know how much compressing the air needed before it would exert a force equal to that of the water outside. If this failed him, he would drown without a doubt.

Taking a Desperate Chance

He decided to take the chance. So, groping in the dark, he opened the bilge-valve and let the water in. As it crept up about his waist he philosophically decided that he would much rather drown than suffocate, anyway. But when it reached his waist he grew somewhat nervous and thought he'd better try the hatch.

He pushed against it, and it opened slightly; but it slammed shut again, crushing his fingers, for the pressure of the air was not yet great enough to resist the water without the aid of the hatch.

Nursing his injured fingers, he waited stoically until the water in the engine-room reached the hatch coaming. Then, with just his head above water, his ear-drums strained from the compressed air, he made a final attempt to raise the unwilling hatch.

His patience, bravery, and cool-headedness were rewarded. At last the air was compressed enough to equal the force of the water, and the hatch moved easily.

Physics Sees Him Through

After helping him thus far, physics decided to see him through. The compressed air in the submarine repelled the water which was trying hard to pour in and drown him. The air shot upward with great force, taking the sailor along with it to the surface of the water leaving him there, breathless.

After he had righted himself and shaken the water from his eyes, he looked about and saw, a little distance away, a friendly destroyer, which soon picked him up.

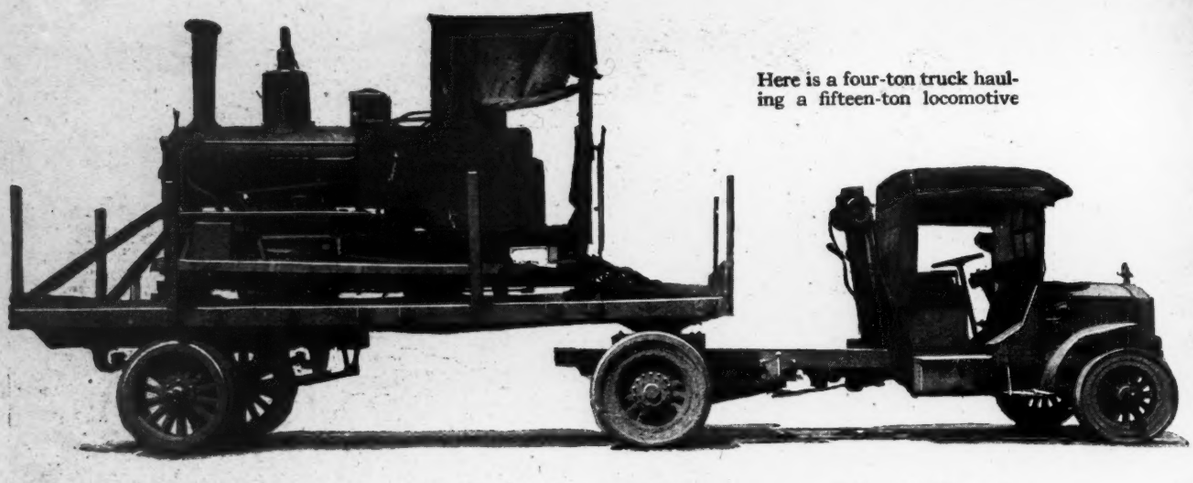
Such an experience must surely force on any man a great respect for school, teachers—and fate.

He Prayed that Air-Pressure Would Help Him to Open the Hatch

Trapped alone in the engine-room of a submarine when it sank, an English sailor was saved by his quick wit and the remembrance of a long-forgotten physics lesson.

It came to him that by letting the water into the submarine the air would be compressed until the pressure inside would equal that of the water outside and he could raise the hatch. He gambled on the chance that the air-pressure would enable him to lift the hatch before the rising water drowned him.

It was a close shave, but he won, and as he raised the hatch-cover the rush of air behind him carried him through and to the surface—alive.



Here is a four-ton truck hauling a fifteen-ton locomotive

Why This Steam Locomotive is Riding on a Motor-Truck

THE illustration above is a relic of the famous Priority Order No. 2 of the War Industries Board, which prohibited the use of freight-cars for hauling road-building materials such as stone, and cement, and machinery.

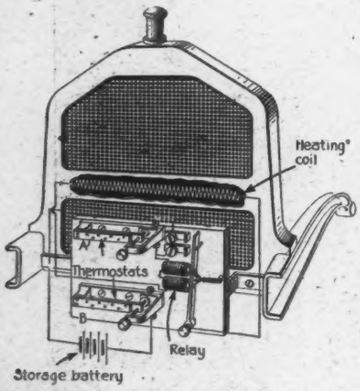
When the Road Commissioners of Wayne County, Michigan, found that they could not get materials to several important roads that were under construction, they turned to the motor-truck for assistance. With the help of a special trailer, a four-ton truck carried the fifteen-ton steam locomotive from job to job, even beating the time by which it had previously been shipped by rail.

The engine was delivered direct to the job with but two handlings, loading and unloading. By rail it required four. First it had to be loaded on a wagon, hauled to the railroad station, and then unloaded. At the end of the run it had to be unloaded on to another wagon from the car and handled the fourth time from the wagon to the ground at the site of the job.

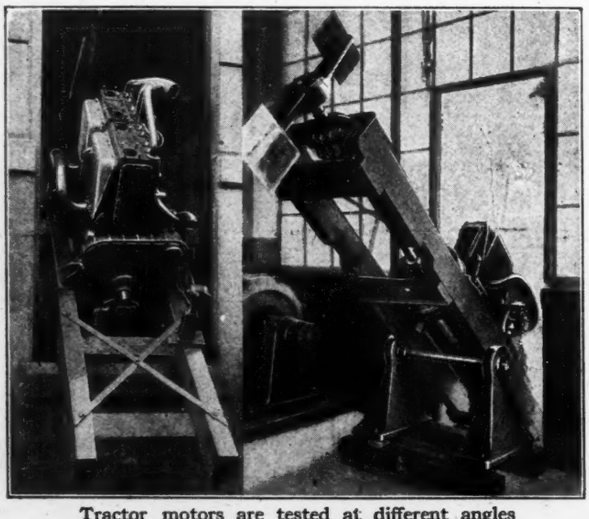
How to Make a Radiator Cool Itself

IN a temperature controlling device for automobile radiators, by Harris S. Coy, of Indiana, the front of the radiator housing is provided with a series of shutters having at one end forked radial arms and springs engaging in a vertically movable bar.

A casing in the upper tank contains a fluid that is quickly expanded by heat. When this happens, the pressure acts upon a piston which causes the rod to open the shutters and admit air to the radiator. When the water becomes cooled, the contraction of the fluid draws the piston upward, closing the shutters.



When the radiator gets too hot, the shutters in front of the housing open automatically and cool it off



Tractor motors are tested at different angles to prepare them for a strenuous future existence

Testing Motors for Tractors

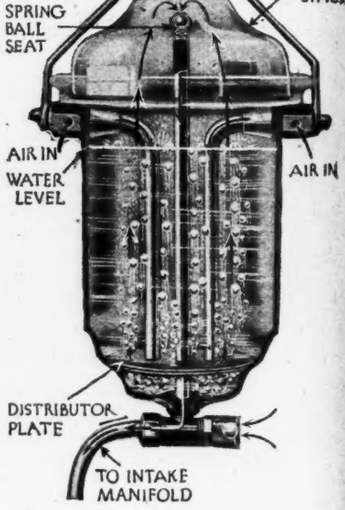
OWING to the varying positions in which a motor for tractor use is operated, the motors shown here are tested on a tilting stand, and must start, control, and operate just as satisfactorily on a longitudinal inclination of 45° as they do on a level plane. During the test on such a stand, this motor showed a fuel economy of .54 pounds per horsepower hour.

It is a four-cylinder engine, bore 6½ inches by stroke 7¾ inches, and is practically an eight-cylinder patrol model motor cut in half, with the oiling system and various other details adapted to tractor work. The motor develops from 120 horsepower at 900 revolutions a minute to 160 horsepower at 1200 revolutions a minute. The total weight is 1,580 pounds.

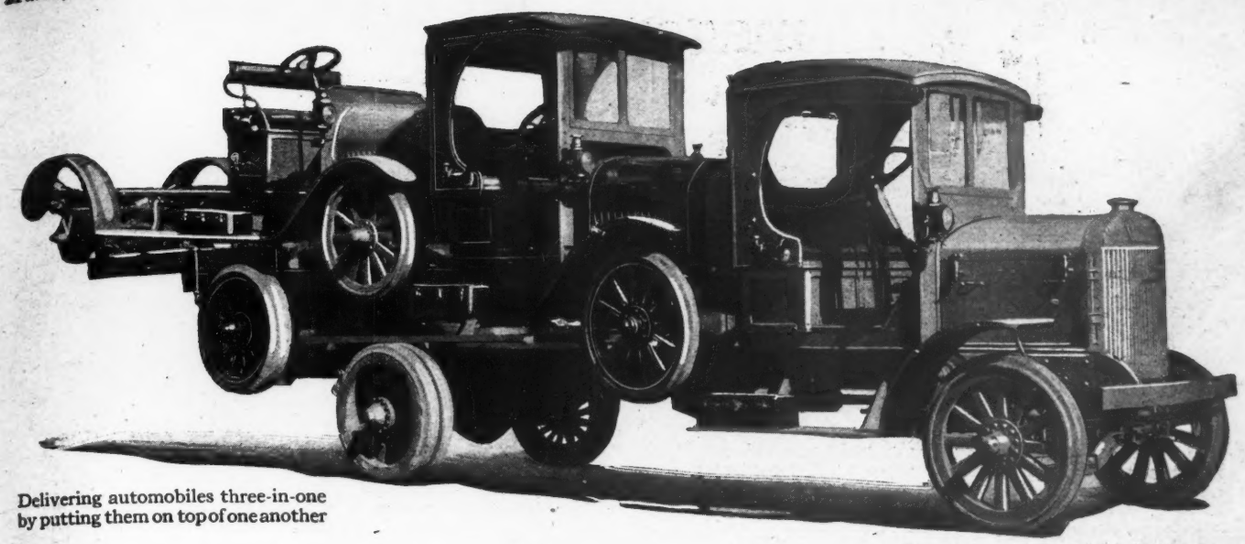
To Moisten Air for the Engine

FOR some reason, moist air gives slightly greater power to automobile engines. A device for moistening the air consists of a small tank mounted under the hood. The water is kept at a level just below the top forming a vapor space through which the moist air passes into the engine.

The air enters through two holes in the top, and follows the course shown in the diagram below.



Does your automobile run better in damp weather? Feed the engine moist air with this device



Delivering automobiles three-in-one by putting them on top of one another

An Arrangement for Carrying Two Trucks on One

DURING the recent railroad embargoes, it was quite common to see a fleet of motor-trucks delivered overland, with each truck carrying as a load a smaller truck chassis. But one truck carrying two smaller chassis was quite another thing. In the case illustrated, the big truck was a 3½-tonner, the next a 1½-tonner, and that on top weighed one ton.

A special framework was mounted on the body of the carrying truck, and similarly a timber extension was used on the 1½-tonner to support the 1-tonner. The method has been used to distribute trucks from a Chicago factory to near-by points and from Pittsburgh as far as Washington, D. C.

The Motor-Truck in a Machine-Shop

WHEN the flood waters of the Grand River short-circuited the electric power-plant of the Michigan Power Company in Lansing, Michigan, it shut down all except one of the factories in that city working on war material. One of the companies got around the difficulty by employing a truck chassis to furnish power to run its tool-shop.

The chassis was simply run into one of the aisles, and a pulley was placed on the rear end of the gear-set to drive the main ceiling power-shafting by an ordinary belt.

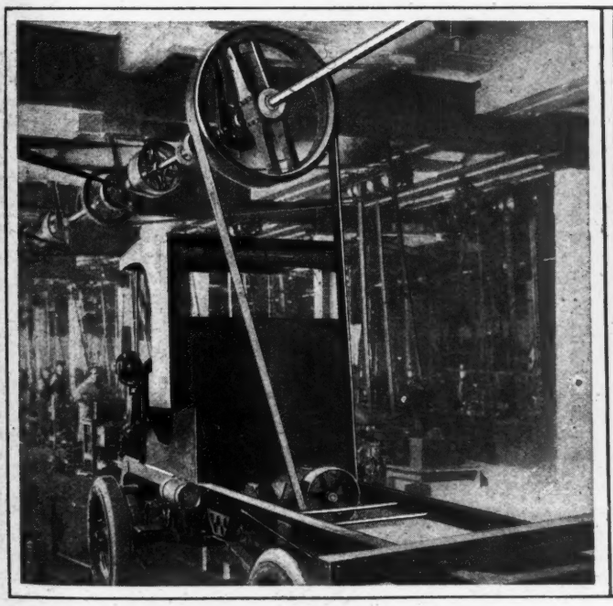
The 40-horsepower engine of the truck supplied sufficient power to run the shop until the waters subsided, so that no time was lost.

An Employment Office on Wheels

IN the shortage of skilled labor an automobile manufacturer of Detroit recently adopted the novel scheme of sending the employment office to the men instead of making the men come to the office.

A special office was fitted up in one of the company's motor-trucks, and the vehicle was sent out on a trip whenever applications at the plant office were unusually small in number.

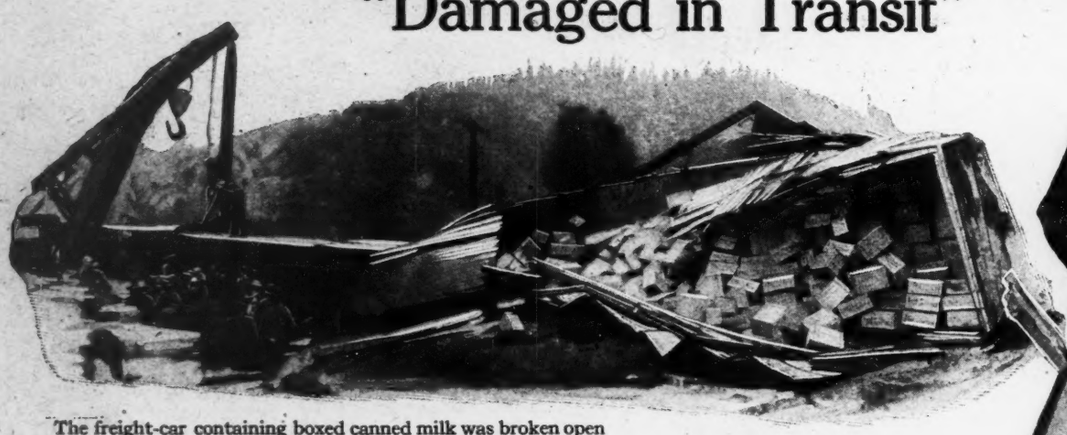
The man in charge of the truck rounds up the men, discovers their qualifications for the work to be done, hires them if they pass the simple examinations given, and motors them to the factory. The traveling office has a desk, files, and application cards in the front part of the truck.



A motor-truck that took the place of a short-circuited power-plant and ran a machine-shop

One end of the motor-truck that was turned into an employment office and went out looking for help

"Damaged in Transit"

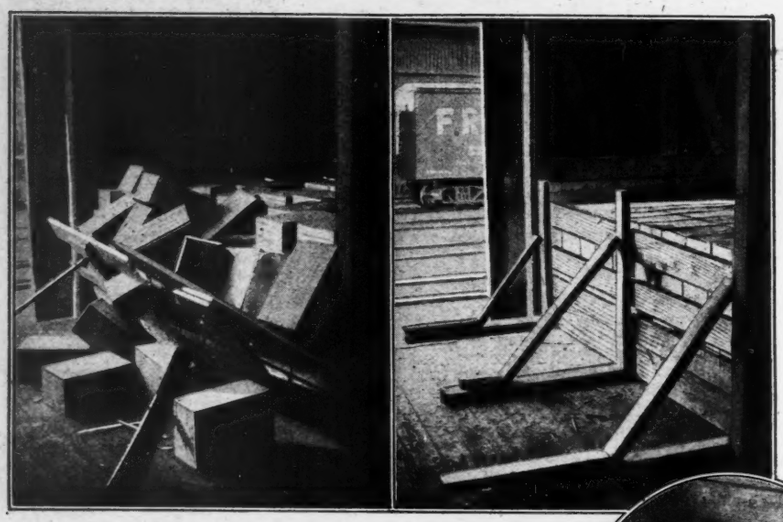


The freight-car containing boxed canned milk was broken open in the train wreck like so much cardboard. But the boxes of milk were uninjured. That shows what good packing means

What kind of a brain was it that conceived the idea of wrapping a mirror in cardboard? The inevitable, of course, happened

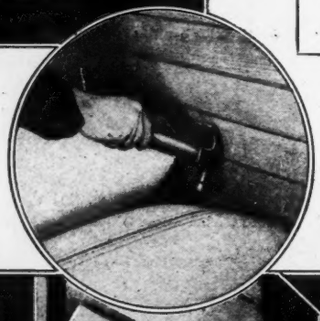
The shipper can help Mr. Hoover by preaching the gospel of proper packing, loading, and clear marking. One railroad alone last year paid $600,000 to settle damage claims. Here are some of the items of that tremendous, needless bill.

Improper loading, frail packages, and rough handling, $284,599; loss of package, $86,255; loss from package, $70,302; wet, $31,527; defective equipment, $5,950.



Some genius thought that boxes of dried fruit would not be scattered in a swaying car if they were braced with a few planks and props. Here is the result

Now cast your eye on these braces and supporting blocks. Crossing the continent, not a box will move from its proper place



It's a wise packer who pulls the protruding nail—the cause of thousands of dollars' loss annually. When a sack is ripped open by a nail, not only are its contents spilled, but the whole pile sags

The barrels are loaded as closely as possible, and the slack in the center of the car and along the doors is taken up with bracings to prevent shifting

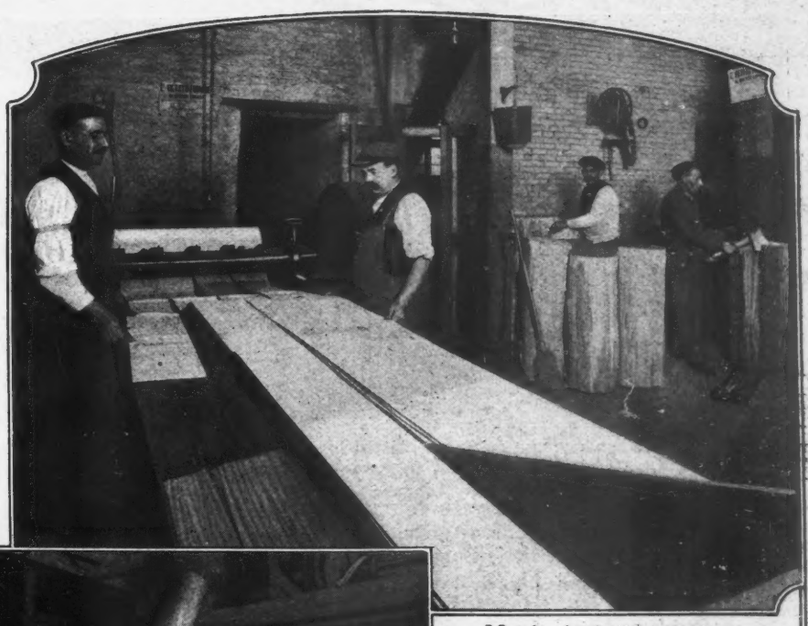
Insecure bracing did it. As the car swayed the boxes at the bottom of the tiers collapsed. Somebody must stand the loss. It's you, as the innocent, ultimate consumer

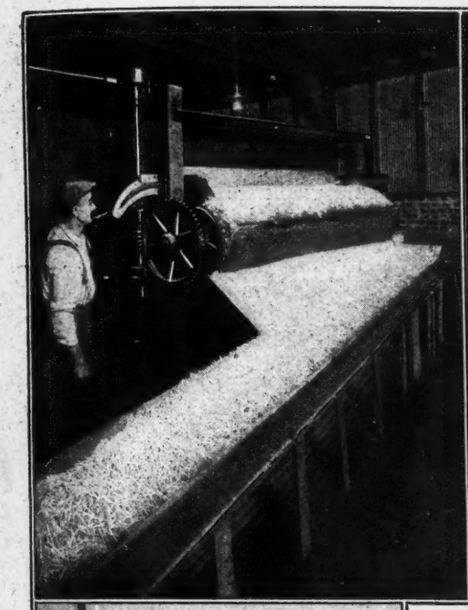
Wire-bound boxes should be loaded as here indicated, with the cardboard containers on top. Obvious? You wouldn't think so if you could see how some cars are loaded

Machines that Take a Log and Turn Out Billions of Matches

Photographs © Press Illustrating Service

Ever stop to think how much time and labor go into the making of that match you throw so carelessly into the gutter after lighting your cigar? There are at least thirteen distinct processes involved and much ingenious machinery. Below, the splints, or sticks, are coming from the drying-machine



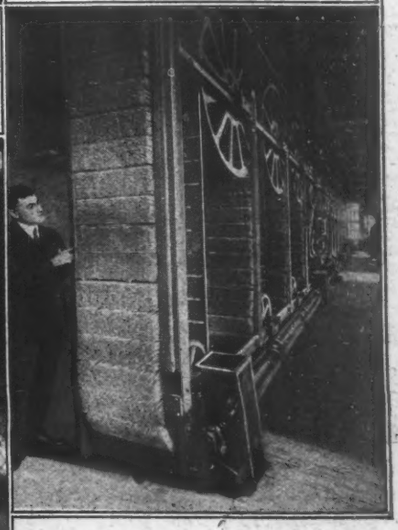


Matches begin life as a three-foot log. First the bark is chopped off; then the log goes through a veneering-machine which cuts it into strips, and these disappear into the chopping-machine, to come out as match-sticks

In closely packed ranks the match-sticks march to the dipping-machine, an arrangement of endless-chain carriers which pass the tips through the fire-making solution. The machine shown below handles 1,000,000 matches at one operation

Chaperoned by these two girls, the machine sorts and arranges the match-sticks. The separate cards of splints are then stacked in shallow boxes, ready to go to the dipping-machine, which provides their business ends

As the match-sticks fall out of the chopping-machine, into the chute, they are sucked up through the large pipe to drying-machines on the floor above



Ready to go out to light the world. At the left is shown the packing-room in a modern factory, where the finished matches are placed in their paper boxes

The medium's hands are in the center, his little fingers being held down by the little fingers of the persons on either side

By substituting one hand for two under cover of darkness and excitement, he gets a hand free to carry on his "manifestations"

Taking the Spirits

How mediums produce some

By Hereward Carrington, Ph. D.,

YOU sit around a table with ten other believers in spiritualism, the hands of all eleven of you spread out flat and your little fingers touching. Next to you is the medium—a big, likable fellow with a kind, frank face.

"If the spirit moves," says he, fixing his eyes on you, "I shall produce some startling phenomena with the very hand that your little finger now touches."

It sounds incredible. "Not if I know it," you say to yourself, pressing your little finger harder against his. You are determined that he shall not remove that hand—not for the fraction of a second.

Then the lights are lowered. Under cover of the darkness, the medium is seized with a series of convulsive twitches and spasms. His hands shake, and the table trembles.

However, you are not to be caught napping. You exert still more pressure on your little finger, and his hand is still there—or was. For lo! a dinner-bell is suddenly rung in your ears, a whistle is blown, a gong is struck, and a flashlight shines in your face.

You are not only amazed and bewildered—you are really scared. And when the lights are turned on, there, just as you anticipated, is his hand with your little finger resting on it. You could swear away your reputation that he had not moved it. How, then, did it all happen?

A Very Simple Trick

Do you recall the instant when he was seized with convulsive twitches? At that time he was drawing his hands nearer and nearer together until, in one violent spasm, he had withdrawn one hand altogether—the very hand under your little finger!

Oh, yes, you regained control of it again instantly, and you forgot all about the loss of it a moment later.

The medium's hands placed on his knees appear to be securely held, but he gets one hand free without your knowledge. (*Above*) You think you have his *right* hand firmly in your grasp, but in reality it is his *left* wrist you are holding

The fact is that the medium substituted the outstretched first finger of his other hand for the little finger of the hand you held—so that then you and the man on the other side of him were both controlling the same hand, leaving the remaining hand free to perform the manifestations. Can you imagine anything which would be more simple than this?

A More Elaborate One

But there are more elaborate demonstrations of the same character. The whole hand of the medium may be apparently controlled; yet he manages to release it all the same! He sits in a chair and places his two hands on his knees, while an investigator sits on either side of him. The man on his right side grasps his right wrist, while the medium himself grasps the wrist of the man on his left side. Thus a circle is formed in which the medium is holding the wrist of one man, and is, in turn, having his other wrist held by the other man. Obviously, the wrist in the grasp of the other man cannot possibly be used to produce the manifestations. But they do take place, nevertheless.

After the lights are turned out, the medium requests the man on his right to remove his hand for a moment.

"I want to use my handkerchief," he says. In a moment he returns his hand.

When he grasps your arm, the medium presses around it a piece of lead concealed in the palm of his hand

The medium has removed his hand, but the lead clinging to your arm gives the impression that the grasp continues

Out of Spiritualism

of their many "manifestations"

Author of "True Ghost Stories," etc.

Returns it? What he does, in reality, is this. He slips both feet forward and crosses his knees, the left knee being on top. Then, when he requests the man on his right to hold his hand again, he allows him to hold his left wrist—the one that is holding the wrist of the man on his left. The right hand is now free. The man on the left cannot tell that the hand has been removed, as, indeed, it has not; and the man on the right cannot tell that any change has taken place in the position of the hands, since he grasps a wrist which the medium tells him is his right hand. Since there is only one knee, the trick cannot be discovered if an investigator feels the other knee.

When the medium's hands are held securely he sometimes produces "spirit touches" by means of a long feather drawn from beneath his waistcoat with his teeth

But some people will tell you that they have received "spirit touches" while they knew they held both hands of the medium securely all the time the manifestations were going on. In this case, the medium blindfolded the sitter, if the séance was held in the light, and with his teeth extracted a long feather from under his vest, and with it produced soft "spirit touches" upon the head, face, and hands of the gullible person.

A Famous Feat of the Eddy Brothers

An ingenious "holding" test, made famous by the Eddy Brothers in their so-called "light séances," was carried out as follows:

Three chairs were placed in a row in one corner of the room. The medium sat in one—the right-hand one, as viewed by the spectators. The other two were occupied by investigators. The medium and the third man (in the opposite end chair) then grasped the arms of the man in the middle, one hand on the wrist and one hand high up on the arm. In this way the man in the middle was able to tell instantly if any hand was removed. A curtain was then pinned over the bodies of the medium and of his investigators. Presently manifestations took place. How?

Under cover of the cloth, the medium abstracted from his pocket a small piece of lead about the size of his hand. He bent this tightly around the arm of the man next to him, giving him the impression of being held by that hand.

Thus the hand could be removed and the impression remain—the left hand still grasping the arm lower down. Both hands were thus felt, while, as we have seen, only one was actually employed in holding the man—the other being free to play musical instruments and produce other "phenomena."

Of course, various levices have been resorted to in an endeavor to prevent mediums from producing "phenomena" fraudulently, particularly in dark circles.

Some of the Devices

Among these may be mentioned rope-ties of all kinds, chains, padlocks, handcuffs, etc., and especially various ways of holding the medium so that he cannot escape. These are known as holding tests. The aim of the medium is to evade these and, by releasing one hand or foot, to produce "phenomena" with the free member.

Sometimes "phenomena" are produced a long way from the medium—so far, indeed, that the sitter feels sure he could not have reached that spot, even had his hands been free. In such cases, the medium has produced from his pocket a long jointed rod, known as a "reaching rod," and after opening it is enabled to reach objects four or five feet away—to ring bells, shake the tambourine, etc.

The above are some of the simple methods by which fraudulent "physical mediums" bamboozle their sitters. I do not wish it to be understood, however, that I do not believe in any genuine phenomena of this kind. On the contrary, I am quite convinced that they sometimes occur. And it is for this reason that we "psychical researchers" are so anxious to eliminate the fraud. Spurious money does not prove that no genuine money exists: it is the same with spiritistic phenomena. I merely wish to warn would-be investigators of possible disappointments.

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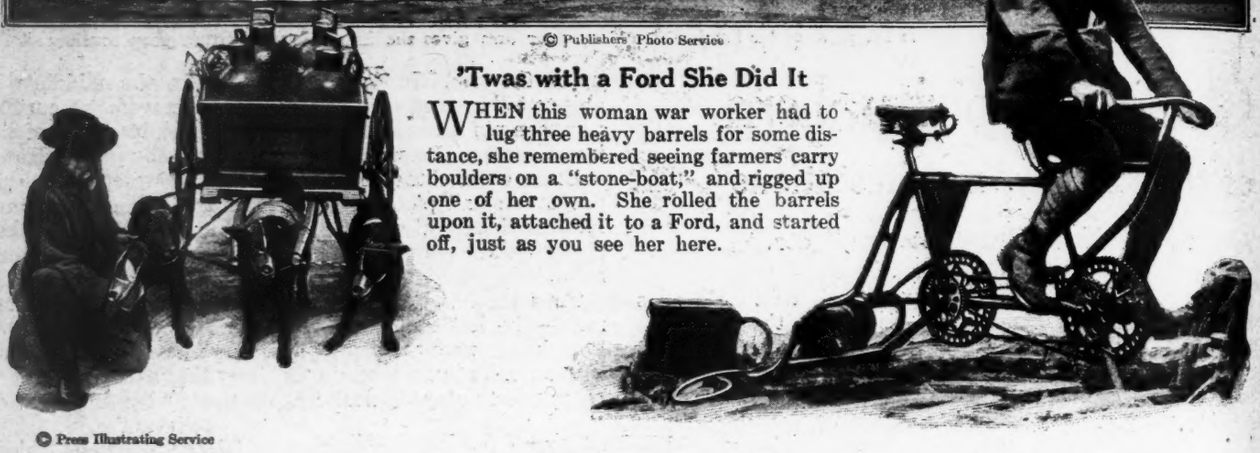
'Twas with a Ford She Did It

WHEN this woman war worker had to lug three heavy barrels for some distance, she remembered seeing farmers carry boulders on a "stone-boat," and rigged up one of her own. She rolled the barrels upon it, attached it to a Ford, and started off, just as you see her here.



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Belgium Moves to Staten Island

WHEN the Belgians fled from their invaded country, some of them did not stop till they reached New York. And then they settled down in Staten Island, starting another foreign colony in already half-foreign New York.

Some of these strangers in a strange land have become Americanized, but others keep their Belgian habits and customs. The man shown here brought his milk-cart, cans, and three dogs with him. He earns his living here, as he did over there, delivering milk.

A trip to this Little Belgium would be just as interesting to strangers sight-seeing New York as a trip to dark and dingy Chinatown. The quiet Belgians on Staten Island lived through the first terrible days of war and could tell many an interesting tale.

Bicycles Come Back to Their Own

WHEN motorcycles arrived, the faithful bicycle was for a time neglected. But when the newness of motors had worn off, people began to look up their old bicycles.

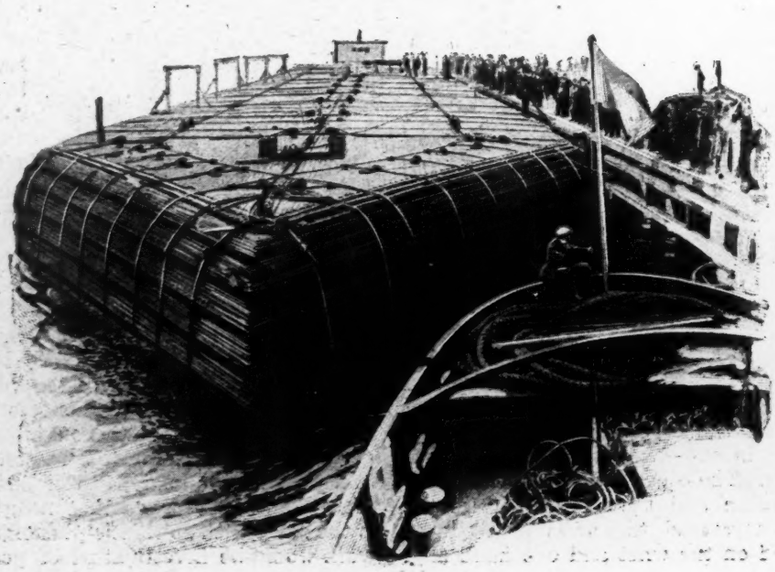
The one shown here is generously helping out a motor. This motor is used to generate electricity for the wireless outfit to which it is attached. The wireless man had no way of starting the motor, so he got out an old two-seated bicycle, took off the wheels, and mounted it on stands. Then, by a series of gears and chains, he connected the bicycle with the motor.

When he climbed on board and started to pedal, he started the gears which, assisted by the chains, turned the motor, and so generated electricity.

A Cargo of Wood that Shipped Itself

SWEDEN wanted to send four huge cargoes of wood to Denmark. Had this desire seized her before August, 1914, ships would have fought for the job. But the war was on, and all the ships that hadn't been sunk by submarines were too busy to bother with wood. As a result, Sweden's wood lay for months in warehouses, waiting patiently for idle ships. But the ships were never idle.

One fine day when wooden ships grew popular, the owners of the woodpile decided to make a huge raft out of it and then tow it off. As the wood was cut in long, thin strips, the job of piling it together was a difficult one and lasted nearly six months. The wood was held together by steel cables and wires so well arranged that not one beam slipped out during the trip.



The raft was about fifty feet wide and four hundred feet long. It stood ten feet out of water and fifteen feet below. When it was finished a crew of seven men were assigned to it. They watched for possible breaks in the wires while two small boats towed her to Copenhagen.

This picture was taken just after the remarkable raft reached Denmark.

The Sense of Justice of an Orange

AN orange has admirable ideas of right and wrong. He does not believe in cheating the poor public. One young orange hanging on a tree watched disapprovingly as dealers charged exorbitant prices for his brothers in influenza days. An idea occurred to him.

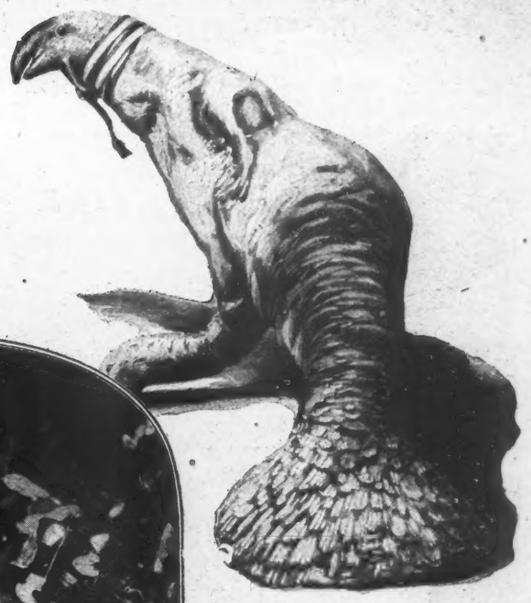
He absorbed all the sunlight he could, drew from his tree quantities of nourishment, and grew and grew and grew, until picking-time found him eighteen inches in circumference and weighing fully three pounds.

© Western Newspaper Union

Upon My Sole!

SHOES of all kinds and sizes are smilingly accepted by the girl in the picture, who sorts them and then sends them to Belgium. She is sitting in the midst of enough shoes to fill two large freight-cars, and yet she smiles for more: for there are still many shoeless feet over there in Belgium.

The war is over, but the damage done by Germany will be felt for a long time, so we must continue shoeing the Belgians, as we did in war-time days.



A Beet that Tried to Be a Parrot

IF the curator of a museum had found this fellow first he could easily have convinced us that it was some prehistoric bird belonging preferably to the *Psittacus erithacus*, or parrot, family. But it fell into the hands of beet-growers—which, of course, is natural, since it is a beet.

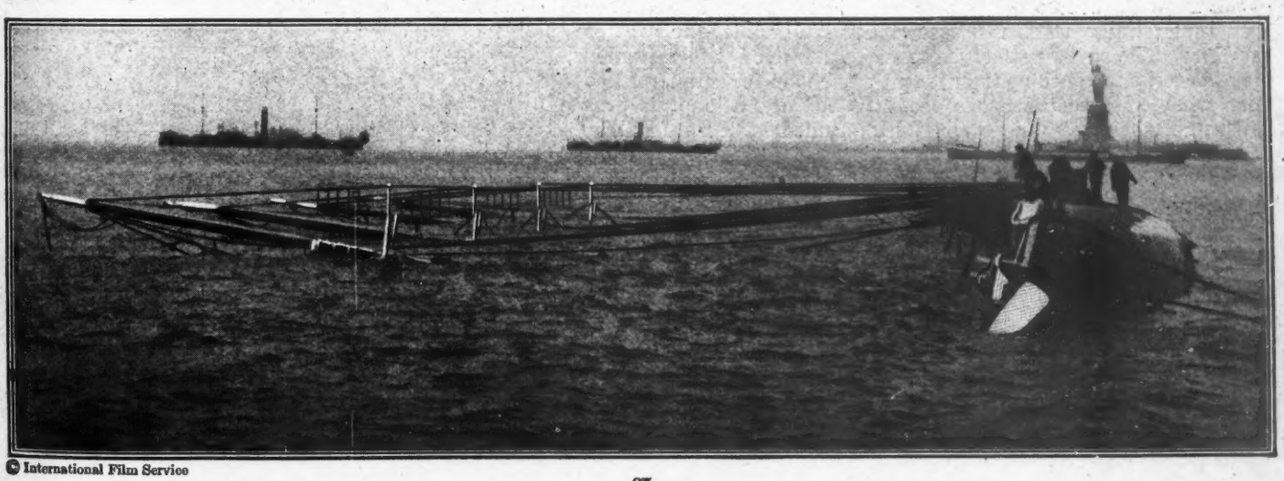
Its great resemblance to a parrot attracted the attention of the farm-hand who dug it up, and he handed it over to them. The growers dressed it up with a glass eye, put a ribbon around its neck, and trimmed the beet-tops into tail-shape.

They then exhibited him as an example of what unusual, ambitious beets grew on their truck farm.

Putting Him on His Feet Again

ACCORDING to Robert W. Chambers, author of many best sellers, "Valeries" stir things up considerably when they appear. He seems to have figured them correctly, for one *Valerie*—not one of his fair ladies, but a large freighter—recently caused much commotion in New York harbor, As she steamed down the bay, she bumped into a 726-ton schooner whose name is *Dustin G. Cressy*. *Dustin* toppled over without a struggle, but *Valerie* proceeded calmly on her way, unharmed.

Fortunately, the crew was saved, but the ship needed much salvaging. The picture shows several men working on *Dustin's* side, helping to stand him up again. This little drama was enacted in full view of the Statue of Liberty, who frowned on it with troubled eyes.



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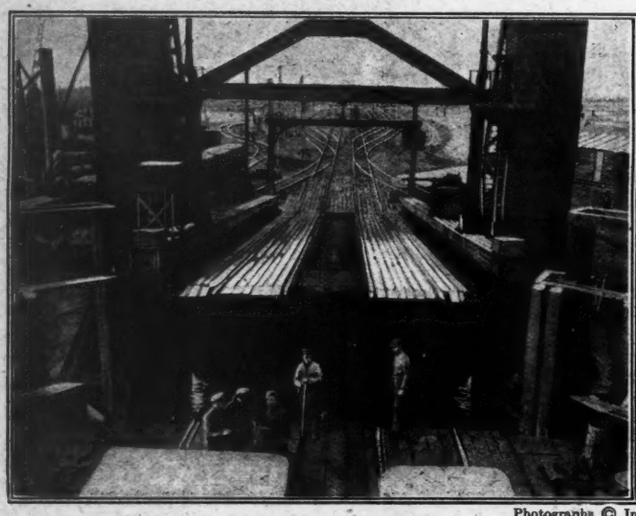
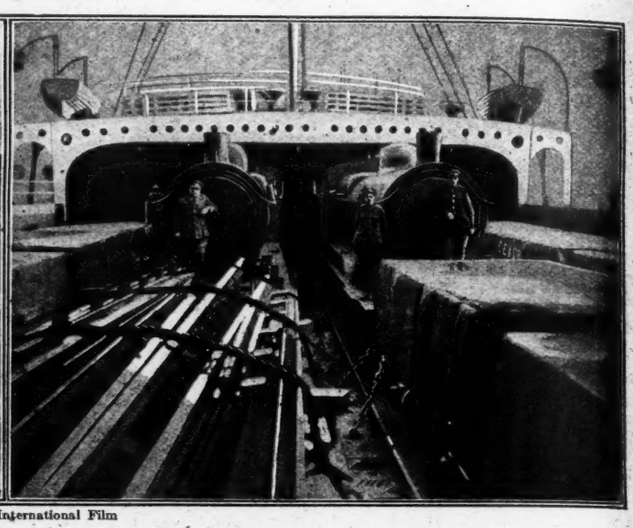
Ferrying War Material to the Tommies

In boats the Germans didn't know existed





Photographs © International Film

Right under the nose of German fliers and U-boats, the British established a ferry at Richborough, a town on the river Stour

Three boats, each carrying fifty-four cars, carried loaded trains across the Channel, where they were transshipped to French railways

GERMAN fliers and U-boats kept a sharp watch on the British Channel coast, and made numerous attacks at different points from which, they suspected, shipments of war material to France were made.

Realizing the seriousness of the situation, the British government resorted to a ruse which succeeded remarkably well. About three years ago, a Channel train ferry was established at Richborough, a small town amid the salt marches fringing the mouth of the river Stour, which empties into Pegwell Bay, between Ramsgate and Dover.

Knowing that there was no harbor at that point, the Germans never took the trouble to raid this part of the Channel coast. The British government built extensive magazines at Richborough, and established a ferry-house with an adjustable platform provided with a double track.

Three ferries, each with a capacity of fifty-four fully loaded British standard railway cars on their wheels, or the equivalent in locomotives, tanks, automobiles, etc., were placed in the service. Alternately they took aboard their quota of cars loaded with war material, and carried them to France, where the trains were transshipped to the French railway lines and speedily taken to the front. The ferries returned from France with empty trains.

The average time required to remove the empty cars from the ferry and to run loaded trains on the boat was about thirty minutes.

He Needn't Go In When It Rains

With his coat like a tent, covering both rider and steed

A MOTORIST will not make for the nearest garage when rain begins to fall; for his seat within the car protects him from actual contact with the rain. But riders of bicycles and motorcycles have no protecting covers and are unmercifully wetted by sudden showers. The result is that they must seek shelter, and continue their journey only when the weather gods see fit. This unpleasantness in cycling has been overcome by a recent invention.

Cycling enthusiasts have every reason to welcome the combined cycle raincoat and cover devised and patented by Roy V. Creery of Wisconsin. The waterproof coat is large enough to cover not only the rider, but also the handle-bars, pedals, driving mechanism, and saddle of the wheel. A high collar, which may be turned up and fastened in that position, protects the head and neck of the rider.

The coat opens on the side, and is held together securely by snap buttons. The closing seam of the garment is made water-tight by providing for two flaps on one edge, between which the other edge is placed when the coat is buttoned. The coat has no sleeves. To enable the wearer to unbutton the fastenings, a side opening, protected by a flap, is provided. The front part of the roomy and tentlike garment covers the handle-bars and is attached to them and to the front fork.

There is nothing complicated about this raincoat. It is easily put over the shoulders of the rider and the driving and steering mechanism of the wheel and quickly fastened to the front fork and the handle-bars. The rider can get out of the garment without detaching it from the machine.

Protected by this ample garment, the cyclist can brave the elements without fear of a drenching

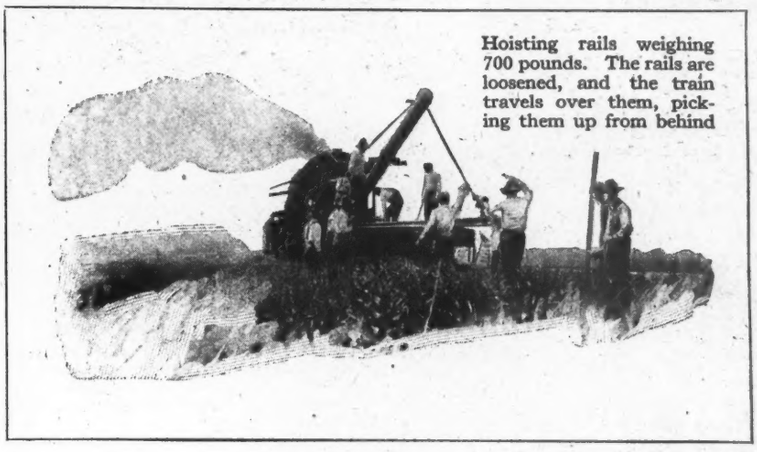
Buying Railroads for Junk

This man purchases bankrupt railroads, scraps them, and then sells the material in every part of the world

IMAGINE, if you can, buying railroads just to scrap them. It seems like an impossible proceeding, but it is not. Herman Sonken, of Kansas City, buys railroads, tears them up, and sells them as a sort of glorified junk.

When Mr. Sonken was a boy, his desire was to own a railroad. He has not only owned one, he has owned many. When a railroad gets into the hands of a receiver and has to be sold, Herman Sonken is likely to buy it.

First he finds out how many locomotives, how many cars, how many ties, bridges, and roundhouses belong to the road. He then makes an offer for it. When he has acquired it he scraps it. The cars he uses to transport the other equipments of the railroad to its destination. The roundhouses are torn down, scrapped, and placed on flat-cars and in box-cars, and when he has used these cars for transporting the best of the material, they in turn are scrapped.



Hoisting rails weighing 700 pounds. The rails are loosened, and the train travels over them, picking them up from behind

How the Rails Are Handled

The wrecking is all done with Mr. Sonken's own machinery. The rails are taken up by a machine built specially for the purpose. A crane mounted on the end of a 30-foot car reaches over a 33-foot car in front of it. The bolts are taken out of the rails, and they are then hoisted on to the car by machinery which grasps them through the bolt-holes.

The rails are loosened on the inside, and the train travels over the loosened rails and picks them up from behind. Since the wrecking train travels slowly, there is practically no danger of the rails spreading and causing a wreck. By this method it is necessary to have a crew of only twenty men to pick up the rails, where ordinarily it would take thirty or forty.

The bridges are taken down, and, if in good condition, are sold to other railroads. The cars that are in such condition that they may be repaired are sent to the "hospital," refitted, and sold to other railroads. If they are in a very bad condition they are simply sold as scrap metal. Locomotives are overhauled and resold wherever it is possible.

When a road has been completely dismantled, and nothing remains but the ties, they are sold to the farmers along the way at a rate of $90 a mile. These are treated with creosote and make excellent fuel. The farmers find them even more satisfactory to burn than coal.

A large amount of the railroad equipment that has been scrapped by Mr. Sonken is now over in France. He marks the rails and cars with his name so that they can be identified. Only recently a young man from his office, who was fighting in France, recognized some of the Sonken rails. Parts of Sonken railroads may be found in practically every country in the world.

One that he bought was sent almost bodily to England. With the thirty-six miles of rails went six freight-cars, two combination passenger-cars, three locomotives, and six steel bridges.

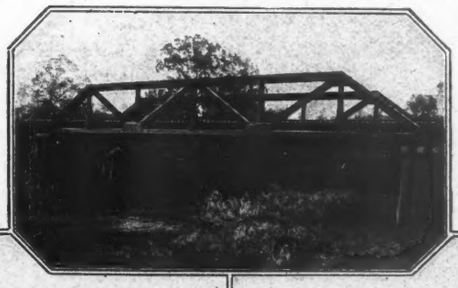
Unlike most business men, "live ones" are not what Mr. Sonken wants. He always waits until the courts have written the obituary of a railroad. So, although he has owned many roads,—seven or more,—he has never operated one, and all but one of the seven were long since junk.

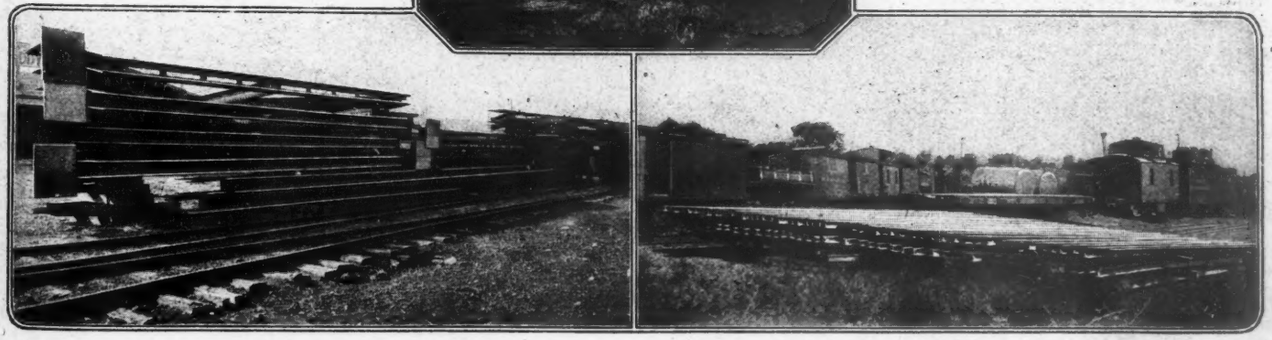
The Exception to His Rule

The exception was a short line in Iowa. Mr. Sonken was called in to look at the property.

"As a railroad it's worth nothing to me," said he, "but as junk I'll give $21,250."

He got it. Then, before salvage operations could start, he was offered $250 more than he had paid by a man who wanted to keep the breath of life into the line. It was characteristic of Sonken that he took his $250 profit and let the road live.

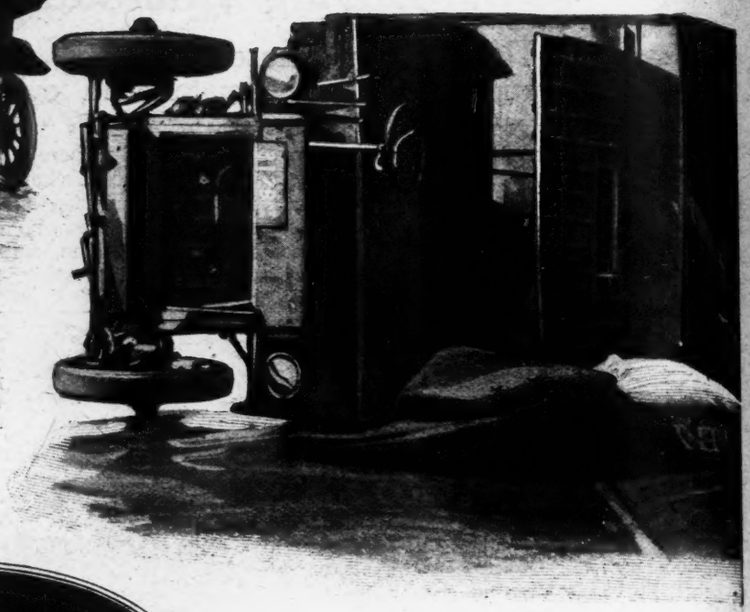




Bridges from a railroad scrapped by Herman Sonken. The upper picture shows a bridge before it was dismantled

Box- and flat-cars and other equipment ready for shipment. There are twenty acres of space filled with valuable junk

No chains, slippery road, too much speed —that's the formula for the perfect smash. The results, when followed faithfully, may be seen here—wind-shield and top broken off and two wheels missing. The car turned completely over in the smash

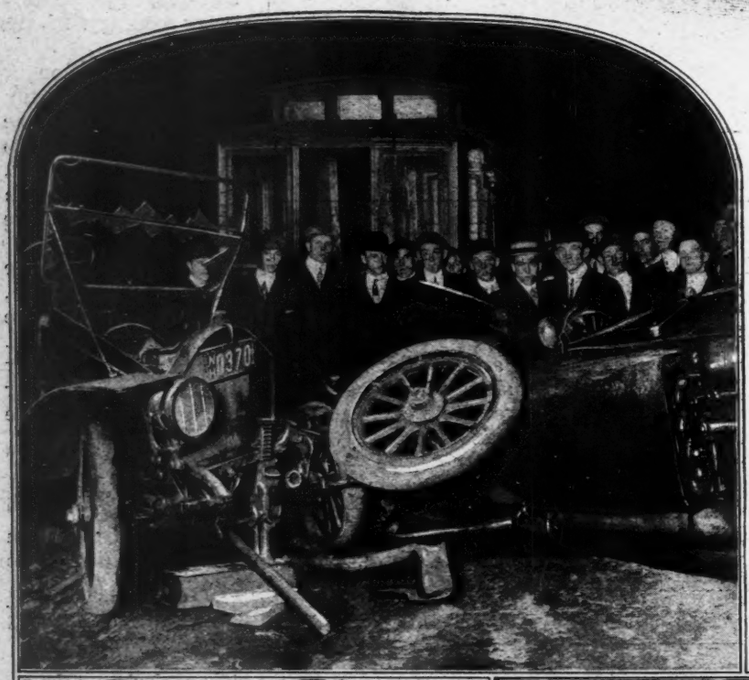


"Always room for one more" is the motto of the moving-van crew, and they usually finish off by lashing your pet bit of furniture on behind, making a topheavy load

How Automobile

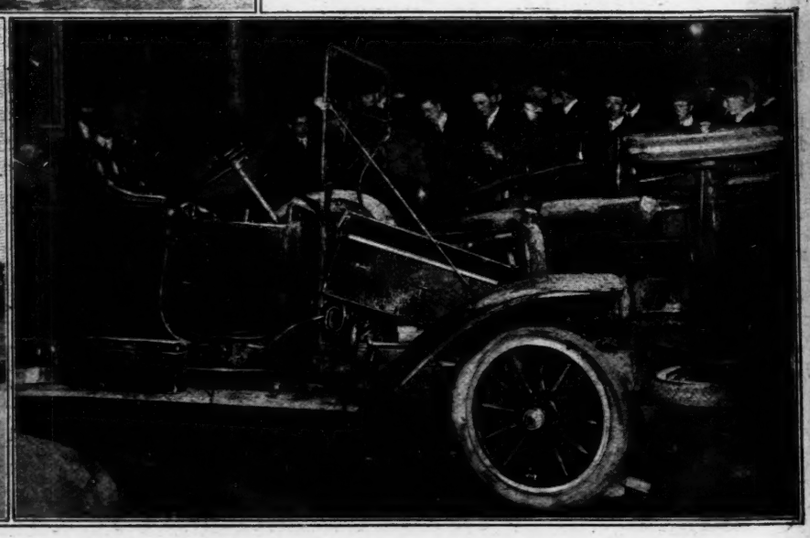
The Case of Safety First

Photographs © Publishers' Photo Service



Poetic justice! The big car tried to crowd the little fellow into the ditch, and got the worst of it

Another case of "Forgot my chains." Add a little too much speed and a sharp turn, and you don't need imagination to guess the rest



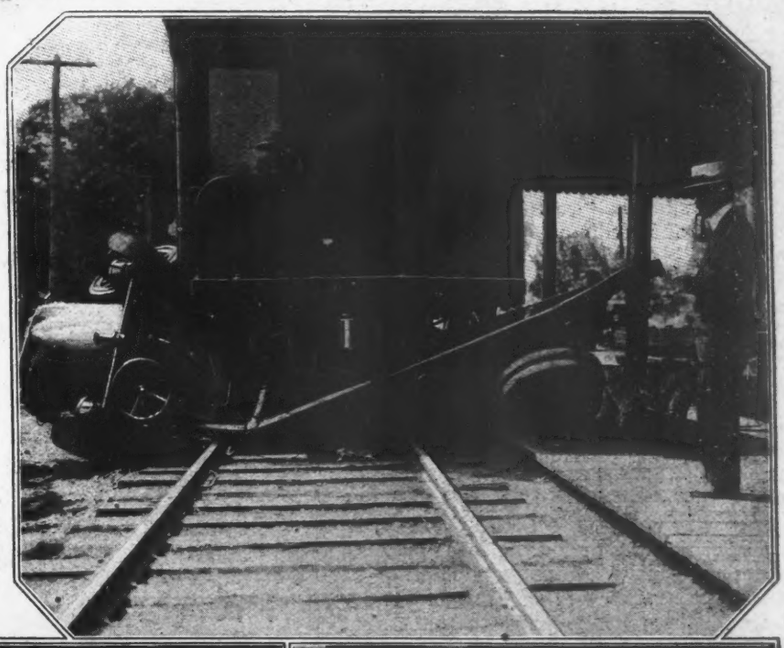
Both cars had their headlights on full when they met, and both drivers, blinded by the other fellow's glare, misjudged the distance. The crashing head-on collision followed as a matter of course

Usually the center of gravity is kept below the danger line; in this case they got too much stuff atop, and the driver spilled the beans by making too short a turn

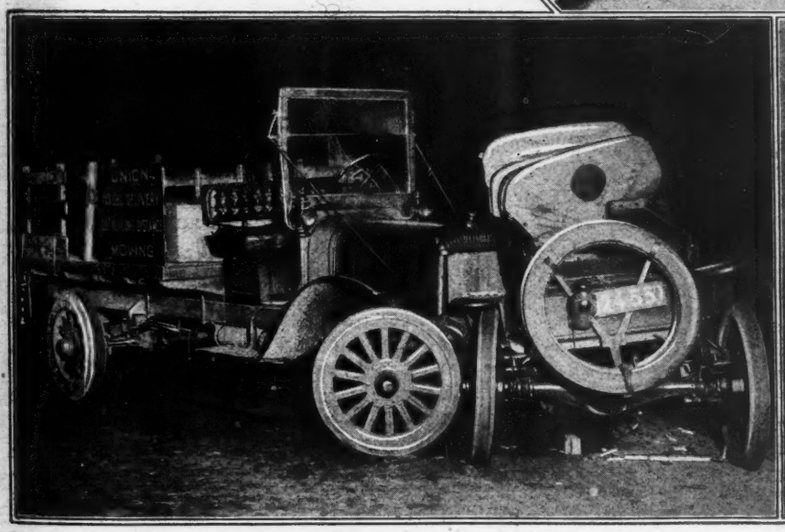
No, the taxi didn't get tired and try to lean against the tree to rest. This is merely another example of the motorists' great sin of omission—no chains

Accidents Happen *vs.* the Careless Driver

Photographs © Publishers' Photo Service



Tried to beat the train. If he'd won he'd have saved thirty seconds. For this he gambled his car and his life



The driver of this car, which was rammed amidships by the truck in the picture, turned out of a lane into a busy main road without looking to see whether the way was clear

Poor headlights were the cause of which this is the unpleasant effect. The driver simply tried to turn a corner before he got to it

If the Bell Rings You're a Bad Shot

Instead of announcing a bull's-eye, the *ting-a-ling* says you're a trigger-jerker

By Captain Edward C. Crossman, U. S. A.

ABOUT ninety-five per cent of successful rifle or pistol shooting lies in the smooth release of the striking mechanism of the arm that fires the cartridge. Trigger "squeeze" instead of jerk is the hardest thing to teach a beginner, and it is the first thing he forgets when he shoots hurriedly or under excitement. He is not alone in this; for the veteran shot gets spells of fudging or flinching, and they usually go hand in hand with convulsive pulls of the trigger.

The Novice's Dread of Noise

The novice jerks the trigger, displacing his aim and sending his shot wild, usually because he's afraid of the noise and the kick of the gun, and also because he tries to make the shot go when the sights are just right, and, in the parlance of the rifle shot, he "quits holding and pulls the trigger." The experienced shot can make his shot go when the sights touch the spot, but the recruit has to arrive at this stage by way of the gradual trigger squeeze.

Trigger-jerking is one of the most difficult tricks the instructor has to overcome. At the Small Arms Firing School of the Army, at Camp Perry, Ohio, the pistol instructors feel that, when they've got the student officer past this jerking period, he lacks only practice to make a good pistol shot.

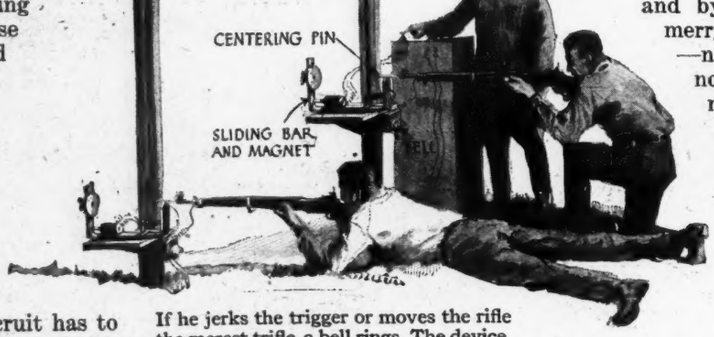
Except by the wild shooting of the learner, the trick is hard to detect. If the gun is empty, he doesn't, as a rule, jerk the trigger. If it is loaded, the recoil usually covers up the movement produced by his yanking habit. Veteran instructors "get the goods on him" by the old trick of making him think he's pulling the trigger of a loaded gun when it is really empty, and noting whether the arm moved as the striker fell. This exposes without curing the trouble.

To Cure the Trigger-Jerker

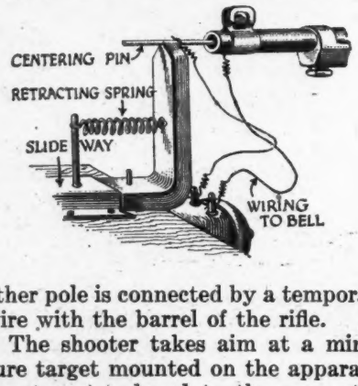
The best way to cure it is to "catch 'em young," and to train them so carefully in the preliminary practice with empty rifle and with small-caliber gallery rifle that the careful trigger squeeze is accomplished without thought.

The most valuable accessory yet invented for detecting and demonstrating to the shooter himself bad trigger squeeze, is the Coleman aiming device, which infallibly and violently rings an electric bell when the shooter jerks the trigger instead of squeezing it. It is in use by the United States Army, having been adopted by the General Staff.

It consists, primarily, of a slidable frame carrying a steel peg a trifle smaller than the interior of the bore of the rifle. The steel peg is connected with one pole of a dry battery; the other pole is connected by a temporary wire with the barrel of the rifle.



If he jerks the trigger or moves the rifle the merest trifle, a bell rings. The device that accomplishes this, the invention of an army colonel, is very easily made



The shooter takes aim at a miniature target mounted on the apparatus —a target reduced to the proportion of the outdoor target at some given and common range; then, when he has steadied his aim, the instructor moves the frame carrying the steel pin or peg until it slips into the muzzle of the rifle. It is a trifle smaller all round, and as long as the rifle is held steadily it does not touch the bore. With the steel pin protruding into the bore, and the rifle held steadily as the rifleman aims, the instructor closes the electric circuit, save for the gap between the steel pin—one side of the circuit—and the barrel, the other side. The least jerk of the rifle muzzle will move the bore against the steel pin, close the circuit, and ring an electric bell that is part of the apparatus. Then, with all this cooked up for the benefit of the learner, he is told to aim carefully and squeeze the trigger as if firing an actual shot at the target.

Ringing the Bell with New Meaning

If he has mastered the trigger squeeze, and lets off as he must to do accurate shooting on a real range, the muzzle does not move, the circuit is not closed, and the bell does not ring. If, however, he jerks the trigger or moves the rifle the least bit in letting off, the bell buzzes merrily, and bystanders hand him the merry ha-ha. There is no alibi —no bad cartridge to blame, no puff of wind, no cant, no mirage. He didn't get off with a smooth trigger squeeze, and the bell told the tale—told the same tale the target-marker would have told, without allowing the various excuses usually dug up for bad shots when in actual range practice.

After a séance of preliminary training with this device, with its "bawling-out" bell to tell to all men the tale of the trigger-jerker, the recruit either learns proper trigger squeeze beyond all chance of forgetting it, or else he's without the pale of possibilities as a rifle shot.

The relation between the steel pin and the bore depends on the skill of the firer. The inexperienced marksman couldn't even hold steadily enough to avoid closing the contact with a pin as near the size of the bore as that which the crack shot could use without trouble; but, once he's learned how to hold steadily, the pin can be so large as nearly to touch the bore, and still never close the circuit when the trigger is let off.

The device, the invention of a colonel in the army who understands the difficulties of rifle training, is cheap to make up and simple to operate, the total accessories necessary for the production of rough but serviceable copies being merely a dry battery, a bell, a little wire, a nail of the right size, a piece of 1x12-inch pine board. Add a simple switch for closing the circuit when the aim has steadied down, and you are all ready to begin the test.

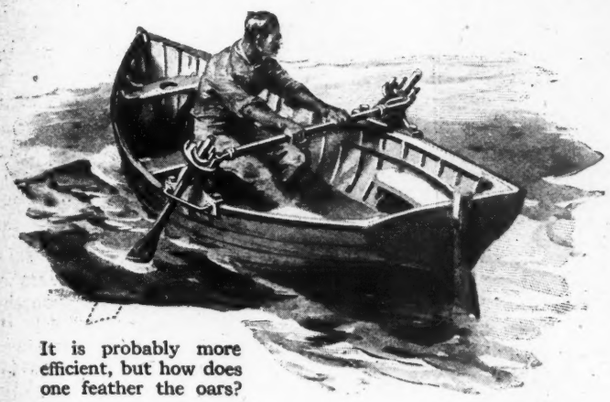
No Catching Crabs with These Oars

DO you know what "catching a crab" means in the language of sailors and fisher-folk? Watch a person unskilled in the handling of oars attempting to row a boat in comparatively still or slightly choppy water. He may make the first pull bravely; but on the back stroke the blade of one of the oars catches the crest of a little wave, and almost invariably the oar is lifted out of the oar-lock. That is called "catching a crab."

Charles J. Olson, a Brooklyn inventor, has recently obtained a patent on a device which makes it impossible for even the most awkward amateur oarsman to do this.

On each side of the boat a slotted plate is attached to the gunwale, and the shaft of the oar is fastened to a retaining plate which allows the oar to move forward or backward and to turn, but keeps it from becoming detached from the boat. Each of the oars has above the gunwale a sleeve attached to the shaft of the oar, and the two sleeves are connected by a bar which is pivotally connected with an eccentric plate attached to the sleeve.

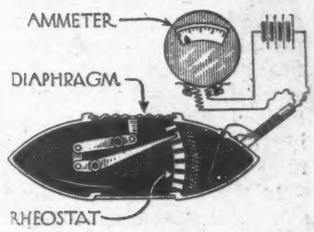
In rowing, the oarsman grasps the bar and pushes it alternately forward and back. At one motion the oars take the pressure of the water and propel the boat, while at the back stroke the eccentric of the sleeve gives to each oar a quarter turn, bringing its edge against the water. At the next stroke the flat of the oars is again turned to take the pressure of the water. The turning motion is produced by the eccentric plate engaging pins in a stationary plate also attached to the sleeve and upon which the rotatable eccentric plate rests. By properly stopping the position of the eccentric plate in relation to the stationary plate the boat may be rowed forward or backward.



It is probably more efficient, but how does one feather the oars?

The variation of depth of water over which the boat is passing is recorded on the dial before the helmsman's eyes

The Dial Registers Soundings



A DEPTH registering mechanism patented by A. O. Mason is inclosed in a water-tight casing, towed along the bottom. The mechanism comprises a pivoted, circuit-closing lever, the long end of which is adapted to move over the alternated contact and insulated sections of a rheostat. The short end is connected with a flexible diaphragm set into the wall of the casing. Any variation in depth results in a corresponding inward bulging of the diaphragm, which is transmitted through the levers to the circuit-closing lever-arm moving it across the plates of the rheostat, thereby transforming the water-pressure on the diaphragm to electrical resistance, which is transmitted to an ammeter in view of the helmsman.

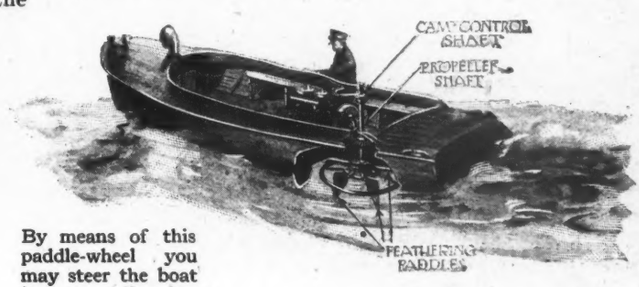
Propelling and Steering a Boat with a Feathering Paddle-Wheel

TO the list of devices for propelling and steering boats, a New Jersey inventor, David Lindsay, has added a paddle-wheel with feathering paddles, to be operated in a horizontal position, submerged under the boat.

The paddles are pivoted in the hub of the paddle-wheel, with their outer ends in a ring. The journal studs at the inner ends of the paddles are pivotally mounted in a hub-like casing which forms the lower end of a tubular sleeve that revolves in a packed journal set in the bottom of the boat. The paddle-wheel receives its rotary motion through this sleeve, which by means of a cone-gear is connected with the driving mechanism.

Through this sleeve runs a vertical shaft having at its upper end a lever which may be turned in a horizontal plane and fixed in any desired position. At the lower end of the shaft, which extends into the paddle housing, is a ring with a cam groove which consists of an upper and a lower section, connected by slanting grooves.

Crank arms extending from the journal studs of the paddles engage in this groove by means of anti-friction rollers, and, as the paddle-wheel revolves around the stationary shaft, the crank arms, moving in the cam groove, impart a quarter-turn to the paddles during one half of their rotation.



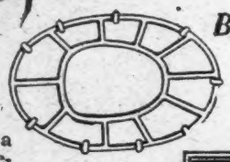
By means of this paddle-wheel you may steer the boat in any direction

Parachuting to Safety

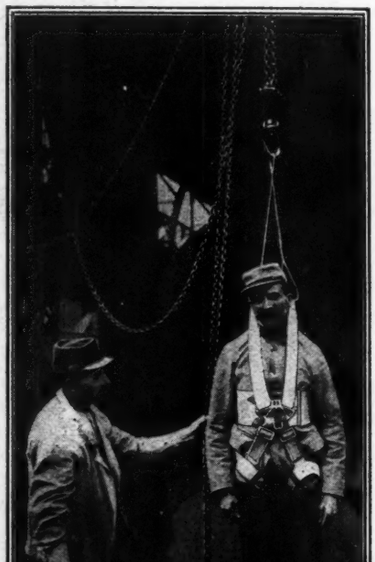
Why it is hard to provide the right kind of parachute to save brave men whose flying-machines have been crippled

By Waldemar Kaempffert

Gerrit Van Daam is one of a number of inventors who believe that a parachute can be worn on the head. He has shown a keener realization of the difficulties of escaping from a crippled machine than most inventors. His invention will work, while their contrivances are usually suicidal.



Plan View



The parachute is usually attached to a harness worn by the pilot. This picture shows how the harness is tested.

Van Daam knows that the parachute must be fastened to a body-harness; he would use the head merely as a place to carry the parachute. He makes sure that the wind will open the umbrella, for he provides openings in the helmet that cannot be obstructed.

FOR the same reason that sailors are not responsible for the adoption of life-preservers and are notoriously poor swimmers, aircraft pilots set their faces against safety devices. The parachute is almost as old as the balloon; yet no aeronaut would use it except to make farmers at county fairs gasp in astonishment at the sight of a man releasing himself from a fire-balloon, stepping into space, and floating down safely, slowly, and gracefully with a giant umbrella.

In the great war of the nations we saw the first wholesale use of the parachute by officers who had been sent aloft in captive "sausage" balloons to watch the effect of artillery fire on the enemy, and who had to jump for their lives when the hydrogen-filled envelope by which they were supported became a target for incendiary machine-gun bullets fired from hostile airplanes. Time and time again, they had seen a comrade drop from the clouds with sickening swiftness. They had seen brave Lufberry unstrapping himself and leaping overboard from his ignited craft after an encounter with a German armored plane. They had seen men vainly struggling to right machines the controls of which had been shot away. And yet, they persisted in rejecting the only form of life-preserver that could possibly be used.

Reason Behind the Prejudice

Behind this unwillingness to equip the airplane with an obviously necessary safety device lie both prejudice and solid sense. It is one thing to drop from a balloon or airship with a parachute—quite another to drop from a flying-machine. In a gas-supported craft a man has a certain freedom of movement, for which reason the act of "stepping over" is no more difficult than leaping from a high roof. In an airplane it is otherwise. Although he can unbelt himself, rise from his seat, and leap overboard, the problem of providing him with a trustworthy

It's Supposed to Work in Air and Water

David Williams Ogilvie invented this life-preserver to save a man not only from being dashed to pieces, but also from drowning. The aviator is to wear a "foundation" garment that resembles a one-piece bathing-suit, and over this a double-walled rubber suit, which can be blown up with air. Ogilvie thinks that the air will miraculously help to break the fall if the parachute should fail to work. The parachute (too small to be of any service) is fitted to a collar and to ribs like those of an umbrella. Just raise your arms and the parachute opens. But there are so many things the matter with Ogilvie's invention that we really can't begin to enumerate them all here.

$500 for a Parachute Prize

LIEUTENANT LOUIS BENNETT, of the British Royal Air Force, was killed in a flight at the front. His mother, Mrs. Louis Bennett, has offered five hundred dollars to the Aero Club of America, which sum is to be awarded as a prize to the inventor who produces the best means of enabling a man to escape from a disabled flying-machine by means of a parachute. A committee has already been appointed by the Aero Club of America to formulate the rules of the contest and to pass upon the devices submitted.

The POPULAR SCIENCE MONTHLY'S article on parachutes gives to inventors a clear idea of the problem that confronts them, and also indicates the means that have been suggested in the past to provide an efficient safety device. Those who care to enter the contest should communicate with the Aero Club of America, 297 Madison Avenue, New York City.

But It's Only a Dummy

This photograph of Baron Odkolok's dummy (see picture below) coming down in safety after the cannon has been automatically fired seems to make out a case for the Baron; but it is our opinion that he has not even begun to nibble at the problem.

life-preserver is accompanied with grave mechanical difficulties. The parachute must be extraordinarily compact when folded; it must be stowed away so that it will not hamper the pilot; it must not retard the machine in flight; it must not foul the rigging at the crucial moment.

Mechanical Difficulties

But this is not all. The flight of an airplane is mechanically so different from the drifting of a free balloon that it may be necessary to jerk the pilot out of the machine by means of the parachute itself. When, for example, the controls of a machine have been shot away and the machine drops in a flat spin, the aviator who has leaped overboard may find himself overtaken by the plane, and his parachute torn to shreds by the propeller.

What of the Peace Machine?

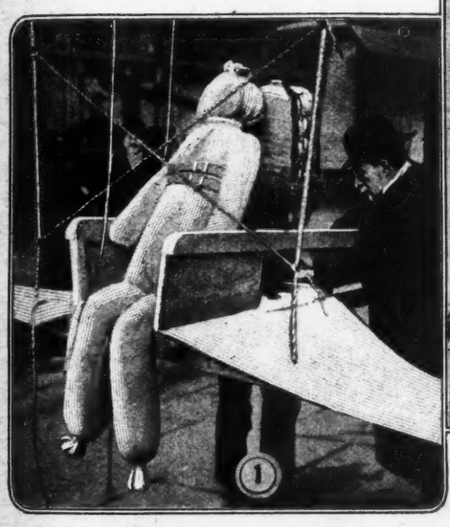
Similar objections might be raised against the use of life-preservers at sea. No one demands that a life-belt shall save an ocean liner's passenger in every perilous situation; neither should a parachute be expected to save an aviator in the most freakish of accidents. In warfare, it is true, machines are shot down from the ground, in which case there is no chance to use a life-saver. But what of the peace machine? What of the thousands of machines in which zealous young men learn how to fly? What of the mail-carrying machines?

The Parachute Is His Hat

McLaughlin, an American inventor, proposes to have the aviator carry the parachute on his head. We have taken his idea and improved it so that it may conceivably work. We're not sure but the aviator's neck would be broken when he is yanked out by a parachute that suddenly opens in the 120-mile gale created by a swiftly dropping machine, and so we have attached the parachute sling to the aviator's shoulder-harness. We would pack McLaughlin's parachute in a headpiece, streamlined like an airplane fuselage. The shell forming part of the streamlined parachute bundle falls off when a button is pressed. The parachute, open as its mouth, catches the gale created by the falling machine.

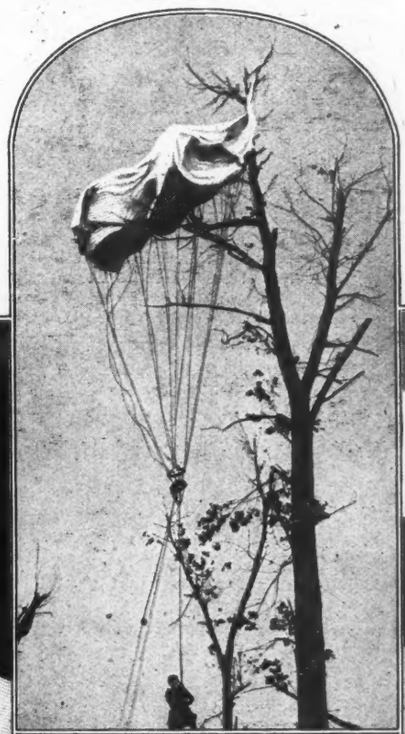
A far more valid objection is the weight of even the lightest parachute. Let it not be forgotten that an airplane, and above all the 120-mile-an-hour single-seater, is a structure in which ounces must be saved; otherwise it cannot fly high or fast. Clearly, a parachute weighing thirty or even forty pounds may not be added without lowering the machine's flying efficiency.

It is obviously difficult to mount the parachute on a flying-machine of the pusher type—that is, a machine on



Would It Work with a Man?

Baron Odkolok of Paris is here shown adjusting his invention to a dummy seated in a dummy machine. In the bundle behind the dummy the parachute is contained. Like most inventors who have busied themselves with making flying safe, the Baron thinks that everything depends on the parachute-releasing mechanism. He connects the parachute rope with a small string, and the string in turn with a little cannon. The aviator unbelts himself, rises, fires the cannon, and thus releases the parachute. See the picture above.



How They Land Sometimes

When a balloonist "steps over," his heart is in his throat, even though the parachute has opened with a roar. Over the battlefield a hostile machine-gunner in the air may try to pick him off during the slow descent. And even though he escaped the machine-gun bullets, he might find himself dangling helplessly from a tree in the branches of which his drifting life-preserver has become entangled. Artillery officers who went up in balloons to observe the effect of gun-fire were taught how to use the parachute in real schools. Mr. Calthrop, an English engineer, advocates similar training for airplane pilots.

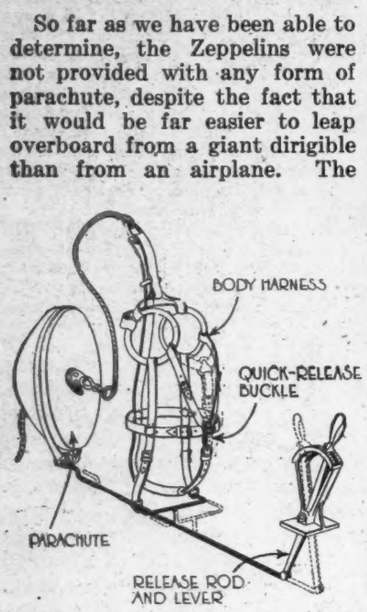
The Way the Germans Did It

The Germans seem to have been the first to use the parachute in actual battle. Time and time again it was reported that their airmen were equipped with such aerial life preservers. A few of them certainly were. Here we have one of their crude devices—an umbrella folded into pillow form and attached to the usual aviator's harness. How well this worked, we don't know as yet, because no official reports on the subject have been published by the Germans.

which the propeller is mounted in the rear, as in a steamship; for the parachute may foul the under-carriage in the process of opening. With a tractor type of machine, however, the parachute can be housed in the rear portion of the fuselage. All things considered, the best type of parachute for airplanes would be one in which the parachute is launched upward.

Zeppelins Had No Parachute

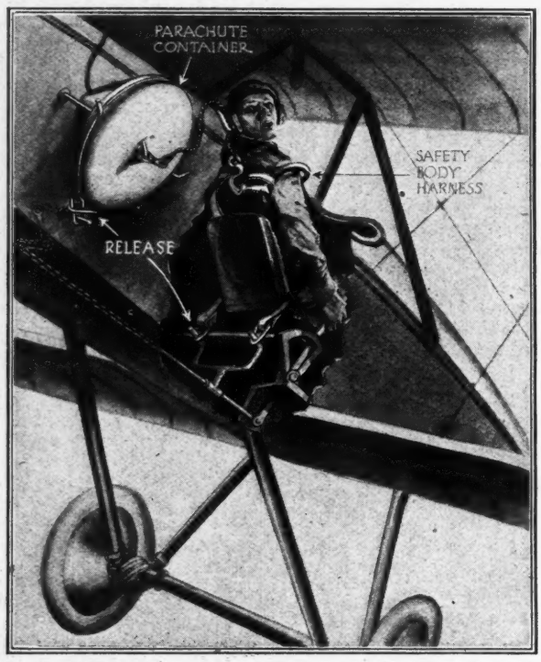
So far as we have been able to determine, the Zeppelins were not provided with any form of parachute, despite the fact that it would be far easier to leap overboard from a giant dirigible than from an airplane. The horror of twenty-two men burned to death two miles in the air, as the result of a single flaming bullet which has found its mark in the huge volume of hydrogen with which the envelopes are inflated, can be imagined. No wonder they often leaped overboard in the hope of finding a mercifully swift extinction below. Even the man in an airplane that has been crippled has a better chance of escape than the stricken members of a Zeppelin that has been hit; for time and time again airplanes, by reason of their inherent stability, have actually reached the ground in safety, even with their controls shot away.



Will the Parachute Open?

The man who drops from a balloon with a parachute abandons himself to a precipitous fall, placing his confidence in the opening of the umbrella in time to break his fall. Parachuting of that kind is out of the question from an airplane, as a general rule. A modern airplane, even in straightaway flight, travels at a speed of from 90 to 120 miles an hour. When it plunges to the ground its velocity is certainly no less.

Most inventors have failed utterly to realize what a veritable storm is created by a high-powered machine, whether it speeds on normally or whether it falls like a bullet. They seem to argue that the whole problem consists in providing some push-button releasing device that will free the aviator and the parachute in a perilous moment.



Simply Pull the Lever and Drop to the Earth in Safety

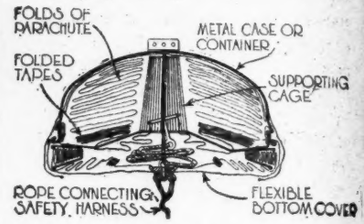
Every airplane parachute is attached to the aviator. Means must be provided to release the aviator so that the parachute may open. Here is Mr. Calthrop's device. The ends of the straps that encircle the aviator's body are so fastened together that by pulling the lever the ends of the straps are freed. Thus the aviator may detach himself from the harness.

How Calthrop's parachute works in an actual emergency.

The inventor who has unquestionably given the airplane parachute the most thought, and who has demonstrated the correctness of his views most conclusively by the severest imaginable tests, is an English engineer, Mr. E. R. Calthrop. Those who remember the earlier tragedies of flying will recall that one of the first Englishmen to fly was the Honorable Charles Rolls, whose name is identified with the Rolls-Royce car. Rolls bought a Wright biplane of an early model—a machine built at a time when very little was known of the enormous strains to which supporting surfaces are subjected in flight. He lost his life in 1910 because of some structural weakness.

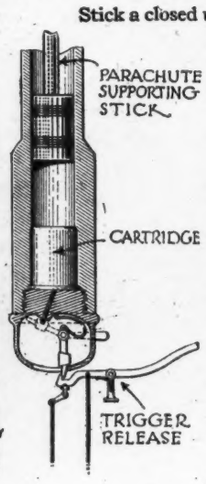
Result of His Friend's Death

Calthrop was a friend of his. It was the tragic death of Rolls that impelled Calthrop to concentrate his engineering attention on the invention of a parachute that would meet the requirements of the aviator. Calthrop has patented several types of parachutes. The accompanying illustrations picture the details of his most important designs so clearly that it is unnecessary to elaborate on them here. For the immediate purpose, it is sufficient to explain that in its more



To Save Man and Machine

Stick a closed umbrella through the top of your machine and the handle into the mouth of a small cannon, and you are applying the ideas of George Giem. George has the gun so arranged that if the engine should stop, the gun goes *bang!* and the parachute is discharged. But suppose George shuts off the motor when gliding down? A locking device prevents the gun from going off. It is clear that George really does not know very much about the problem.



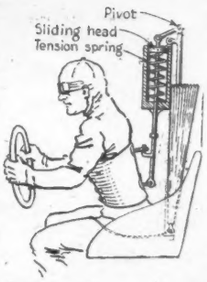
approved form the Calthrop parachute is folded compactly between two disks, each about two feet in diameter, and connected with the machine by a shock-absorbing sling about fourteen feet long. The only free fall encountered is limited to the length of this sling, and it lasts less than a second.

No Shock to the Nerves

According to Mr. Calthrop, "the whole operation of opening takes only two and one half seconds, and there is no shock whatever to the nerves." In unfolding, the sling and the parachute itself fall outside of the disks, the effect being that a cylinder of air is inclosed so that outside air-pressure may not prevent the parachute from opening. Such is the system of packing that the whole action is progressive.

It was in the autumn of 1917 that the Calthrop parachute was publicly tested. An officer leaped from the top of the London Tower Bridge into the Thames below—a sheer drop of 175 feet. The test was made for the express purpose of demonstrating the possibilities of the invention at low altitudes. It proved a complete success. The actual drop was about 140 feet, which shows that even when flying very low in an uncontrollable machine an aviator still has a chance for his life if he leaps overboard with such a safety device.

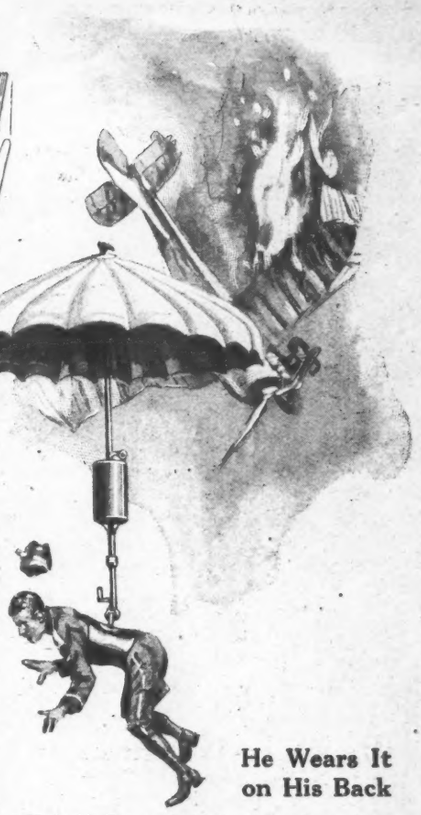
In the present year Captain Sarret of the French army tested the parachute successfully from an airplane at a far greater height from the ground. Sarret's machine was under control of a pilot. Before the war, however, Pégoud, who first looped-the-loop in the air, demonstrated the possibilities of an ordinary parachute—a very much cruder contrivance than Calthrop's—by boldly jumping overboard with it from a single-seater.



Such is the rush of air produced by a modern fast airplane that even if it were flying very low—as low, for example, as twenty-five or thirty feet from the ground—the parachute would still be effective if it is so constructed as to pull the pilot out of his seat. Indeed, a man might thus even leave a sixty-mile-an-hour railway train in safety.

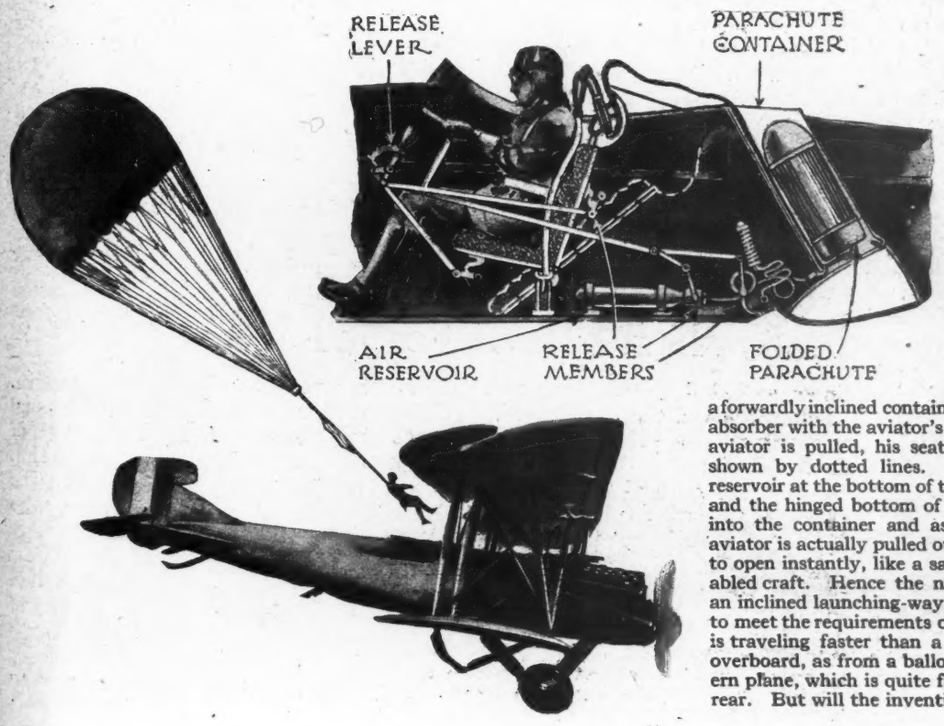
Schools to Teach Parachuting

Mr. Calthrop has urged the need of schools in which aviators will be taught how to use the parachute. It is almost self-evident that, no matter how desperate his predicament, an aviator will try to master his uncontrollable machine. The parachute is not likely to be resorted to until it flashes upon him that it is his one means of salvation. That is not likely to happen until the machine is within a thousand feet or so of the ground. Although Mr. Calthrop has conclusively demonstrated that his parachute will operate when it is only a few hundred feet above the ground, it would be foolish to maintain that the parachute would be effective in every desperate situation, or that it is not more likely to be effective at greater than at lesser altitudes. The untrained aviator will probably be so crazed by the fear of the fate that is impending that he will never think of using the one possibility of escape. After all, aviators are taught at present only to fly, and not to save themselves in an extremity. For that reason, Mr. Calthrop's suggestion that parachuting as well as flying be taught seems to us eminently sane.



He Wears It on His Back

Kaja T. Togstad thinks this solves the parachute problem. The can that Kaja would have you carry on your back contains a spring which raises the umbrella when it is time to jump. The little insert shows Togstad's device in its inoperative position, when the pilot is flying along, recking not of shrapnel or machine-gun bullet. The other picture shows what happens when the machine is struck



Jerked to Safety

E. R. Calthrop is the inventor of this ingenious parachute. The rush of air past a plane, which has made parachuting seem difficult to most inventors, is utilized so that the umbrella must inevitably open in the precious fractions of a second that may separate safety from death. The parachute is packed in a forwardly inclined container, and connected by a cord and shock-absorber with the aviator's harness. When a lever in front of the aviator is pulled, his seat and its back fall into the positions shown by dotted lines. Compressed air is admitted from a reservoir at the bottom of the fuselage to the parachute-container, and the hinged bottom of the container falls, so as to scoop air into the container and assist in ejecting the parachute. The aviator is actually pulled out of his seat. The parachute is bound to open instantly, like a sail, and to jerk the pilot out of his disabled craft. Hence the necessity of transforming his seat into an inclined launching-way. The invention is evidently designed to meet the requirements of those situations in which the machine is traveling faster than a man can fall, so that he cannot step overboard, as from a balloon. It is clearly adapted to the modern plane, which is quite free from entangling appendages at the rear. But will the invention work when the machine is stalled?

© International Film Service

This is the defensive type of the mysterious "P.V.," which saved many a ship from being blown up by mines; the offensive type is still a secret of the British government

Now You Know What a "P. V." Is

"WE ran into a nest of mines, but the P.V. saved us." Thus the young "gob" home from a foreign cruise and spinning a yarn of the perils of floating mines—perils that will exist long after the armistice turns into a permanent peace.

Asked what is a "P.V.," he said, "Oh, that's what the English call 'em. They catch mines"—and let it go at that.

But now that the censorship has lifted, we can show you what a "P.V."—a paravane—looks like, and tell you a little about it, although the extraordinary performances of one type of this machine, made for offensive work, must remain a secret for the time being.

One of these torpedo-shaped devices is swung out from each side of the bow of ships steaming through mine-infested waters. The airplane-like wings near the head serve to keep the paravane out from the ship's side, while the rudder-like contrivance at the stern, operated by an automatic depth-regulating valve, controls the depth at which the P.V. travels. This valve is the same sort that controls the depth at which a torpedo travels.

The wire rope by which the paravane is attached to the ship catches the mooring of the mine, and causes it to travel out to the nose of the paravane, where a sharp cutting instrument cuts the mine free, so that it floats to the surface, is seen by the lookout, and destroyed.

A Cheap Method of Developing Movie Film

THE development of moving-picture films, a complex and expensive process under present conditions, is simplified and cheapened to an amazing degree by a portable apparatus invented and patented by R. P. Stineman, of Los Angeles, Cal. It is so small that the camera man can take it with him anywhere and use it wherever a dark cubby-hole can be found.

The old-method laboratory in any studio costs from one to many thousand dollars, takes up a large space, requires several persons to operate it, and its tank calls for 250 gallons of developer. The new apparatus costs only $50 for the medium size, and the claim is made that it costs only $1 to develop 100 feet of film.

The device embraces a developing reel and three telescoping tanks into which the reel fits. To operate, the reel is placed on a stationary winding pin convenient to the film-box, the end of the film is fastened to the center, the reel revolved with the left hand and the film guided in by the right hand on the outer edge, winding securely on the metal strip.

Then the outer end of the film is fastened to the reel with a metal clip and the whole immersed in the developer, moved up and down rapidly several times to prevent air-bells, and in about twelve seconds that process is completed, and the other tanks come into play.

The film is rinsed, fixed, and washed upon the reel, and finally dropped on a screen in the water

How the Kwakiutl Indians Feasted

HOW would you like to have your dinner served in a dish eight feet three inches long? Before the white man obtained dominion in America, dishes of this size were actually used by the Kwakiutls in their ceremonial observances. Two of these dishes were recently acquired by the Museum of the American Indian, Heye Foundation of New York city.

One of the dishes is carved in the form of a wolf, and is seven feet nine inches in length. The larger one, eight feet three inches long, is in the usual dish form. The ends are decorated with carved heads of bears, with their legs and paws around the vessel's rim.

Feast dishes used by the Kwakiutl Indians. The one on the left, carved to represent a wolf, is seven feet nine inches in length. These dishes were used at the great potlatches, or ceremonial feasts, of Indian chiefs

Although the Indian artist who made these dishes from the trunk of spruce trees had but the crudest of tools, the vessels are remarkable for their symmetry and proportions.

Photographing Music on a Film

A new kind of phonograph inspired by the reel of the motion-picture

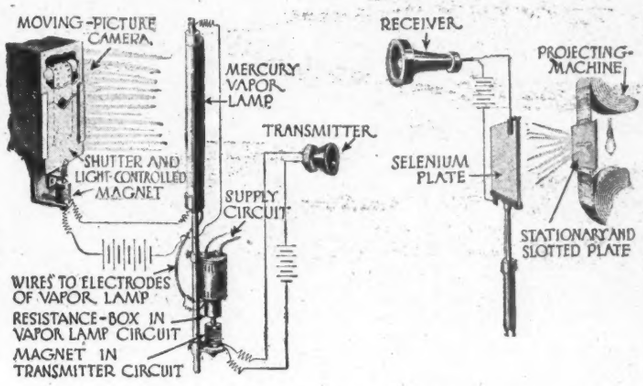
THE motion-picture has this advantage over the talking-machine: You can keep it running for a whole day, and present ever new scenes, if you have film enough; but you can't make a talking-machine disk big enough to reproduce an opera.

Harry Benwell Stocks, of Northenden, England, presents us with a method of recording sound on a film, and then using the developed film to reproduce the sound.

Stocks electrically connects an ordinary telephone transmitter with a mercury-vapor lamp. In the circuit of the lamp and the telephone transmitter is an electromagnet, just beneath the lamp.

Talk or sing into the telephone transmitter, and you vary the amount of current that passes through the electromagnet. The mercury arc is peculiarly sensitive to magnetism. Hence, as the electromagnetism fluctuates with the sound, the lamp flickers. Stocks sets up a camera in front of the lamp. The camera has a shutter which is electro-magnetically controlled by the lamp. As the lamp flickers the shutter opens and closes in sympathy. It is easy to see what happens. The film travels constantly through the camera, as in a motion-picture machine. Talk or sing into the telephone mouthpiece and you make the lamp flicker and therefore expose the film more or less. A record is obtained which looks like a series of zigzag lines.

There is a metal, called selenium, which has the property of varying, in electrical conductivity with the amount of light that falls upon it. Stocks utilizes this property of selenium. He makes his film pass before an ordinary incandescent lamp so that the rays pass through it. In front of the film is a slotted plate. The rays from the lamp pass through the film and then through the slot—the amount depending, of course, on the blackness of the lines of the sound records. The light, which fluctuates with the record, falls on a selenium cell which constitutes part of a circuit in which a telephone receiver is included. The electrical current that flows through the circuit fluctuates, causing the telephone receiver diaphragm to vibrate. The record on the film is telephoned to you.



Miles and miles of music all photographed on a film like that of the motion-picture

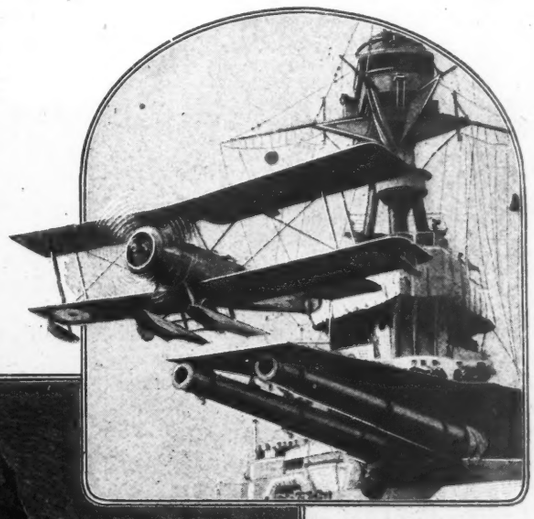
They Take Their Flight from the Muzzles of Guns

WHEN fighting-ships took to sending airmen aloft instead of able seamen, it became necessary for an occasional cruising man-o'-war to have an airplane all its own. It was comparatively easy to get the plane. The big problem was how to fly it; because, with all modern improvements, airplanes are still unable to rise vertically. They have to get a good start, just as some of the larger birds run along the ground with spread wings before launching themselves into the air.

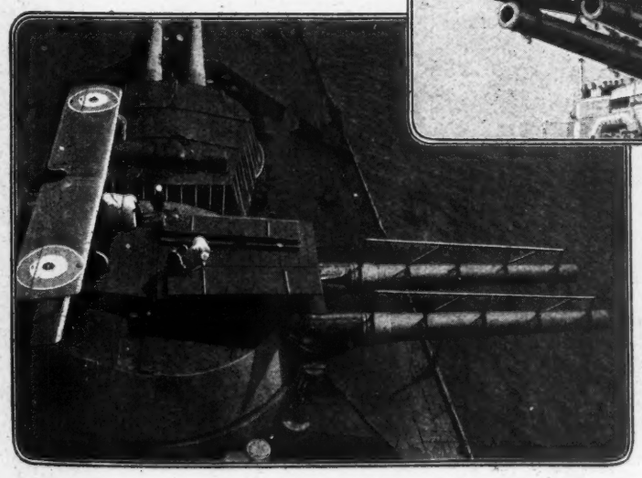
"Mother" ships (such as were shown on page 80 of POPULAR SCIENCE MONTHLY for February) solved the problem for fleets or squadrons large enough to "rate," as sailors say, such a ship; but the lone cruiser had to shift for herself.

One ingenious way of providing the necessary starting platform or runway is shown here. The great guns and their turrets were used as foundations upon which removable platforms could be quickly laid down or taken up. A glance at the pictures tells the story: The plane is lifted by tackles to its perch on the turret-top, the bo'sun's whistle shrills the order to lay the track, the ship swings so that the platform points into the eye of the wind, and the big plane sails out and off.

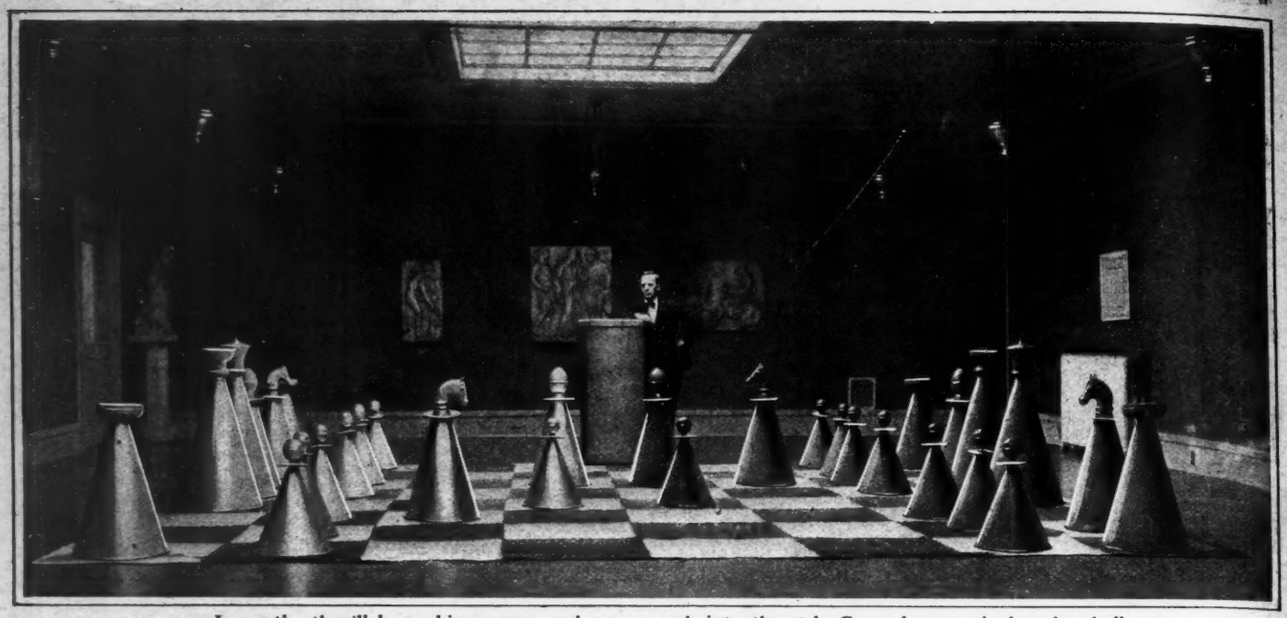
Of course, the plane on returning can't land on the small platform; but, being a seaplane provided with pontoons, it settles down easily in the lee of the vessel, makes fast to a tackle, and is hoisted on board very much as a life-boat would be.



She's off! The seaplane taking flight from the platform laid on the barrels of the turret guns



What looks like a fence built along the barrels of the guns is a foundation for an airplane-starting platform



Presently they'll be as big as men and may march into the Polo Grounds as a rival to baseball

Chessmen Grow in Size and Ambition

A Milwaukeean has great plans for their future

CHESS is going to rival baseball as the great American game. You don't believe it? Well, there is a man in Milwaukee who does, and who has gone to work to make it possible.

He figured that the great trouble with chess as a spectacle is that only a very limited audience can see and be thrilled by the moves. If a game could be watched from the bleachers at the Polo Grounds, he thought, it would be easy to stage chess matches that would put baseball on the skids. Perhaps he's right; but, honestly, can you vision an excited chess fan rising in his place to shout:

"Atta boy! Play your knight!" Or: "Wow, what a bone! White to mate in five moves! White in five, you poor fish!"

The Milwaukee man's plan is to build chess pieces as large as men. They will be made of papier-mâché, so that the chess-players won't get all tired out wrestling with them every time they make a move.

Each of the chessmen is to be made in two pieces—head and base. When the heads are removed from the bases, the latter can be nested one within the other so as to fit into a trunk, the detached heads fitting around the bases.

Making Maps of the Ocean Deeps

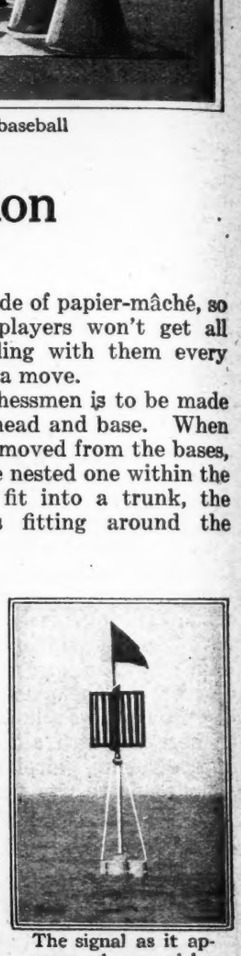
Uncle Sam does it by a new method

MAKING maps of the bottom of the ocean is no easy job. It is somewhat as if a man were to try to get an idea of the earth's surface by drifting above it in a balloon on a moonless night and letting down sounding lines or drags.

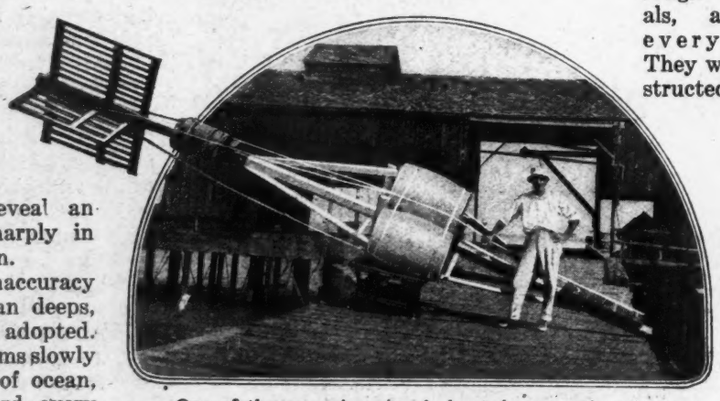
Like the dry land, the ocean bottom has its mountains, valleys, plateaus, and plains. Ordinary soundings give a very poor idea of sea-bottom geography, since soundings taken even a few hundred feet apart may fail to reveal an ocean peak rising sharply in the middle of a plain.

To prevent this inaccuracy in mapping the ocean deeps, wire drags have been adopted. The survey vessel steams slowly over a given section of ocean, and the drags record every variation of depth, and indicate where more detailed surveys should be made.

When this work is done out of sight of land—and therefore of "landmarks"—some sort of floating signals must be provided. J. H. Hawley, of the United States Coast and Geodetic Survey, tells how this problem was solved while the bottom was being mapped off the Florida reefs last summer. The floating signals, although made from rough materials, answered every need. They were constructed of a heavy center pole with a target at the top, weighted at the bottom so as to stand upright, and floated by three barrels lashed to the pole about two thirds of the length down. The mooring chain was attached to a bridle at the water-line.

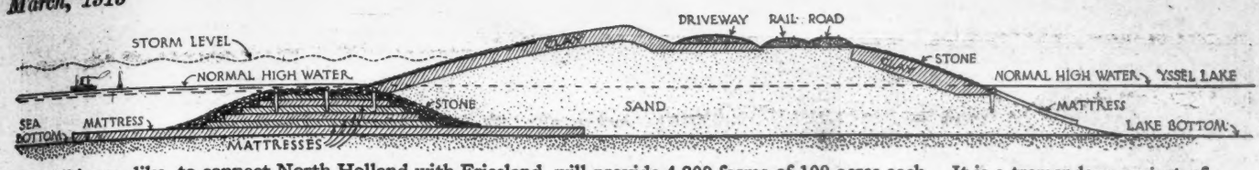


The signal as it appears when used by the map-makers of the great ocean bed



One of the sea-going signals hauled up on the pier

With the aid of these signals, drag work covering 232 square miles was done in four months. It was the first survey of its kind made out of sight of land.



This sea-dike, to connect North Holland with Friesland, will provide 4,800 farms of 100 acres each. It is a tremendous project of the Dutch government, covering a period of thirty-three years, in which American machinery and cement will undoubtedly figure

Holland's Ninety-Million-Dollar Farm

To be reclaimed from the depths of the Zuider Zee and rented at thirteen dollars an acre

By Robert G. Skerrett

HOLLAND is going to reclaim 820 square miles from the depths of the Zuider Zee. This recovered land will create a new-born province large enough to provide 4,800 farms of 100 acres each, and districts that will accommodate 250,000 industrious dwellers. To achieve this, the thrifty Dutch government will expend a sum of nearly $90,000,000.

Investigation has disclosed that quite 90 per cent of the bed of the Zuider Zee, when bared to the sunlight, will make fertile fields; and the plan is to leave the sandy areas that lie in the deeper waters undisturbed, so that there will still remain within the heart of Holland a great internal lake, which in the course of a short while will turn from salt to fresh water and prove a veritable boon to the contiguous agricultural regions.

Presto! The Zuider Zee Is a Lake

The reclaimed areas will be known as *polders*, and the Zuider Zee will be replaced by Yssel Lake. The main feature, from an engineering viewpoint, will be a massive sea-dike, which is to span the gap between the Island of Wieringen and the coast of Friesland, eighteen miles away to the north and east. And then a shorter but equally effective bulwark will block Amstel Diep between the southern end of the Island of Wieringen and the neighboring shore of the province of North Holland.

The purpose of the dam or sea-dike is to shut out the North Sea, and to halt for all time its devastating work through the agency of its offspring, the Zuider Zee. This dike will have a width at the water's surface of more than 230 feet, and will rise a great distance above the sea-level. To protect its outward face from the erosive attack of storm waves, a coating of stone slabs, basalt from Scandinavia, will be employed. The body of the great bulwark will consist of sand on a base of brush and stone, or concrete, with a thick surfacing of clay.

A change in the map of Europe that has nothing to do with the war

It is estimated that 52,971,000 cubic feet of clay will be used in the surfacing. This clay will come from the bottom of the Zuider Zee, and also from the excavation of the canal that is to be built right through the Island of Wieringen in order to permit the accumulating excess water in Yssel Lake to flow out into the North Sea at low tide. This canal will have a width of 3,000 feet, and will be quite 35 feet deep to accommodate deep-drafted traffic.

American Machinery Will Be Used

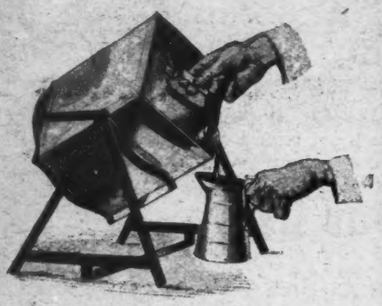
The building of the sea-dike will take nine years, and with its virtual completion will be started the first of the polders. The entire undertaking will require thirty-three years. The first polder will have an area of 53,600 acres, and will be available for settlement in the fifteenth year from the beginning of the sea-dike. The second polder, having an area of 266,240 acres, will be finished ten years later; the third polder, with an area of 77,900 acres, will be ready in the twenty-eighth year; and the fourth polder, of 125,700 acres, will be available to farmers in the thirty-third year. The Dutch Government purposes leasing the farm-lands for an annual rental of thirteen dollars an acre.

The great dike will have a wide driveway for vehicular traffic, and there will run parallel with this a double track railroad which will provide a short route from the province of Friesland to the province of North Holland, thus greatly reducing the distance to be covered in delivering goods at Amsterdam or distributing imports arriving at that port.

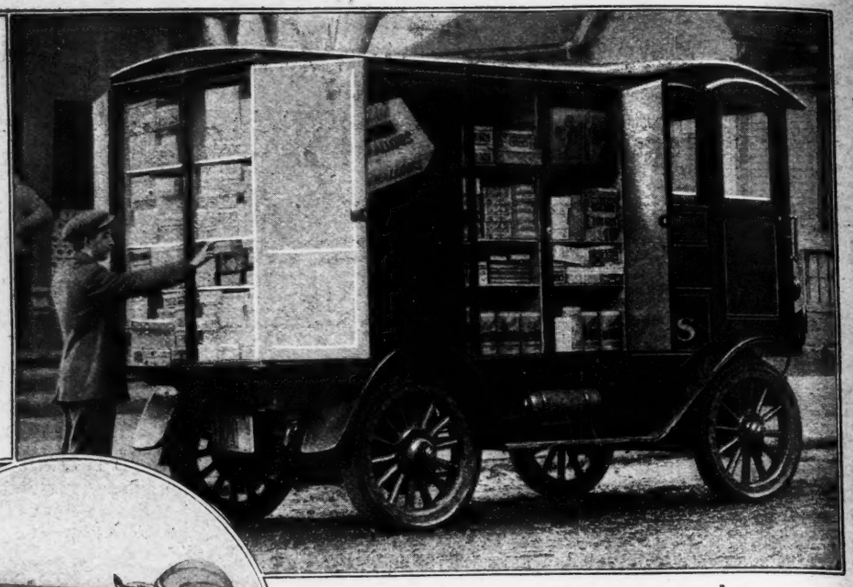
American machinery and American cement will, undoubtedly, figure conspicuously in carrying out this tremendous project.

Hurling a Man from the Earth to the Moon

IN the April number of the POPULAR SCIENCE MONTHLY we are going to take up the question of traveling from the Earth to the Moon. We create no imaginary forces, no astounding materials: we use known forms of energy. Jules Verne suggested the use of a cannon. That will not do, as we will show. Neither an airplane nor a dirigible can be employed, because there is no air between the earth and the moon. There is one possible engine which can fling you into space. It will be a fascinating article. Don't miss it.

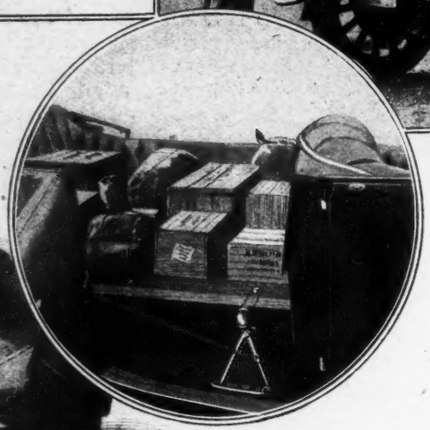


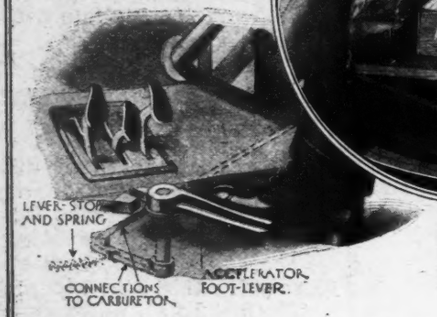
You can avoid wastage of oil by using a tipping device like this to hold your can when pouring out oil into a measure



Doors, both on the sides and in the rear of the delivery truck, expedite the delivery of small parcels and shorten the unavoidable stops

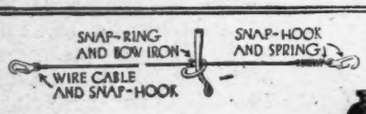
This lever for controlling the accelerator is close to the floor of the car, and is operated by a side movement of the foot, which need not be raised from the floor

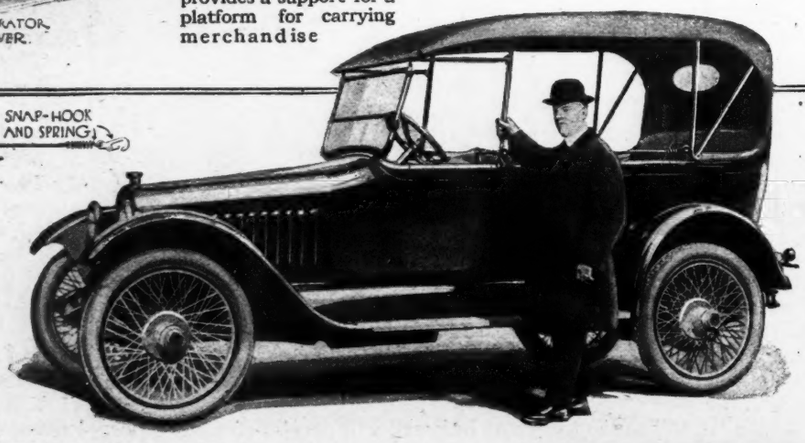




For the Mechanical of the Automobile

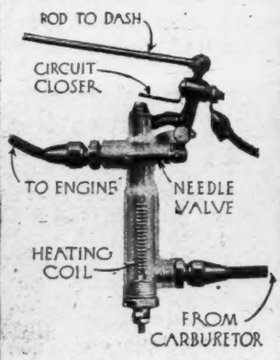
Raising this foot-rest provides a support for a platform for carrying merchandise



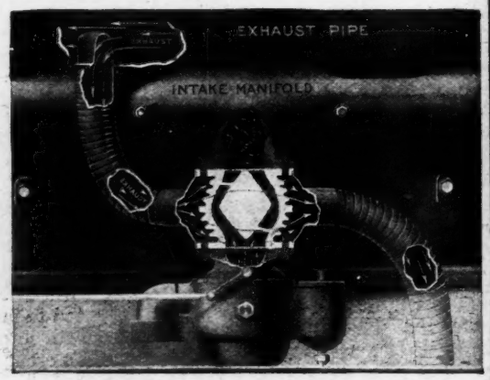


Fastening the bow-ends together with a wire cable on one side enables one man unaided, to raise the top of the automobile

A fastener for carrying your watch on the outside of your overcoat

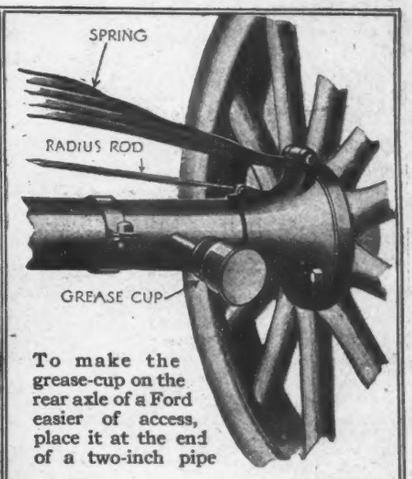


This primer acts as an auxiliary carburetor



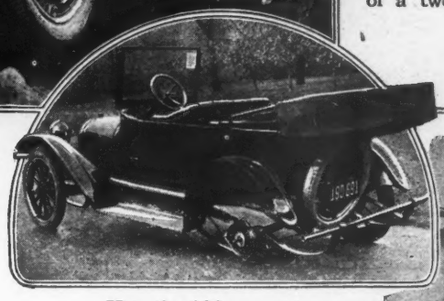
This device utilizes the hot air in the exhaust to heat the gas mixture on its way to the engine

Skids like these are a useful attachment to an automobile. They make it possible to take difficult obstacles

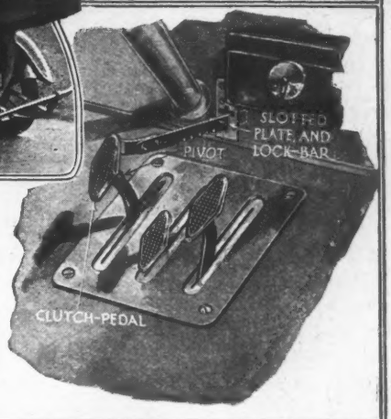


To make the grease-cup on the rear axle of a Ford easier of access, place it at the end of a two-inch pipe

Aid and Comfort Owner and Driver

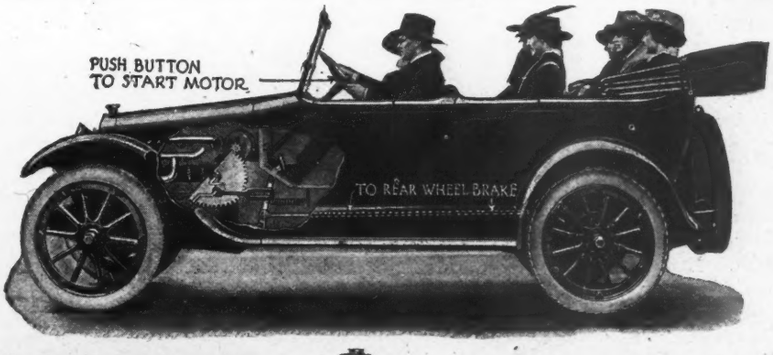


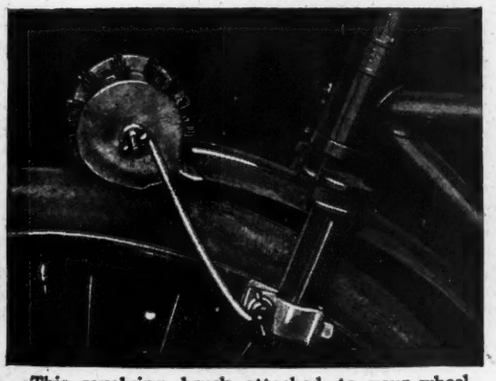
Here the skids prevented a nasty spill after a rear wheel had come off, while going twenty-five miles an hour



This lock-bar will hold your clutch pedal firmly in any desired position

A little switch on the steering wheel starts a small motor which controls the operation of the brakes. A spring returns the device to its normal position when the brakes are off





This revolving brush attached to your wheel will keep your tire clean and make it last longer

A new kind of spark-plug has a little priming cup attached which materially aids prompt ignition

An awning on a spring roller is a convenient attachment to have when you are traveling toward the sun

The *Van Hise* was cut in two. Much too beamy for the locks of the Welland Canal, each half had to be floated through on its side

The first step was to close the bow section with a bulkhead, and to seal the hatches and decks water-tight. In this picture you see the bulkhead that kept the water out

The Story of a Big Ship and a Little Lock

Getting a fifty-foot boat through a forty-four-foot canal

By Joseph Brinker

ONE hundred and ninety lake vessels were taken over by the United States Shipping Board when America entered the war. Forty-eight of these were brought out to the Atlantic seaboard by way of the Welland Canal around Niagara Falls and down the St. Lawrence river before the closing in of the ice in the winter of 1917, and thirty-five more subsequent to the opening of navigation in the spring of 1918.

Many of these vessels were longer than the locks in the canal. It was not a difficult task to cut these in half, bulkhead the open ends, and take them through in two parts. But the *Charles E. Van Hise* (460 feet long, 50 feet beam, and 43 feet 8 inches from keel to gunwale) presented a more difficult problem. She was not only too long, but also too wide. Her beam of fifty feet was six feet more than the width of the locks.

We Need the Ships

Ships are needed now almost as badly as they were when the submarine peril was at its height. Hence the problem of getting the *Van Hise* through was put squarely before the engineers of the Shipping Board for solution.

They accomplished their task with the cutting of the ship in but one place. This was amidships, just as in the boats that had a beam less than the width of the locks. But with that operation the similarity ended. The narrower boats were taken through the locks on an even keel, but the *Van Hise* had to be tipped over on her side and floated on her beam ends, with her deck vertical to the water.

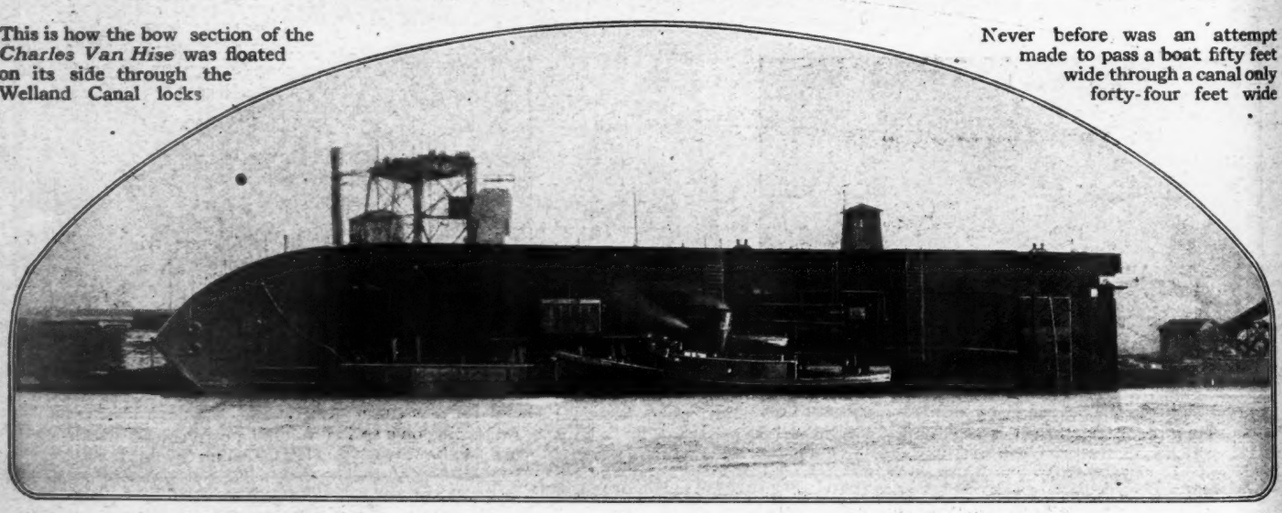
No other ship approaching the *Van Hise* in size had ever to be manipulated in a like manner. The engineers had no precedent to follow.

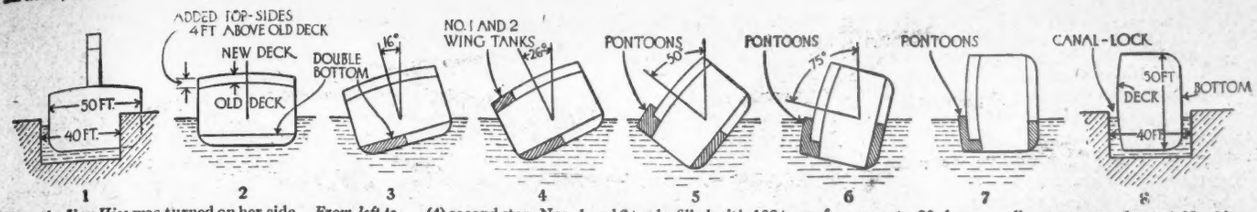
Bow and Stern Separated

The bow was cut in two, turned on its side, and passed through one lock of the canal on December 5 last. The

This is how the bow section of the *Charles Van Hise* was floated on its side through the Welland Canal locks

Never before was an attempt made to pass a boat fifty feet wide through a canal only forty-four feet wide





How the *Van Hise* was turned on her side. *From left to right:* (1) As the ship would have looked on an even keel; (2) a section floating outside the canal; (3) the first step, filling the No. 1 inner bottom with 250 tons of water; (4) second step, Nos. 1 and 2 tanks filled with 130 tons of water (notice 26° angle of inclination); (5) third step, pontoons 1, 2, and 3 filled with water; (6) fourth step, pontoons 4, 5, and 6 filled with water; (7) all the way over to 90 degrees, all water pumped out of No. 2 inner bottom, and No. 1 inner bottom pumped down from 250 to 175 tons, boat balanced and drawing 14 feet of water floating on side; (8) as she looked passing through lock

stern section, containing the engines and boilers, was handled separately. After proving that the daring plan of handling the *Van Hise* was successful, the engineers decided that the season was too far advanced to make it safe to send the ship on her strange voyage. She is wintering in Lake Erie and will make the trip through the canal in the spring.

The first step in the work on the bow section was to bulkhead the cut end, and then to make the deck watertight by sealing all the hatches and covering all the portholes and other openings above the water-line on the side of the ship that would be under the water when the vessel was turned on her side.

Over on Her Side

The next step was to mount six adjacent wood and steel pontoons about nine and one half feet long and between five and six feet deep, on the upper deck of the boat between the forecastle and the rise of the bridge-deck amidships. These pontoons were mounted entirely on the deck and extended clear to the side of the hull, which would be under water when the vessel was turned over.

The boat was now ready for the turning operation. Gradually the pontoons and other tanks inside of the vessel were filled with water, so that she became unbalanced and turned over on her side without any ill effects, much as you turn over in the water while swimming.

The inner bottom on the side toward the turn was first filled with 172 tons of water. This tilted her slightly. Then 130 tons of additional water ballast was added in the side tanks, and finally 466 tons more was pumped into the pontoons, thus tipping the boat until she lay over on her side.

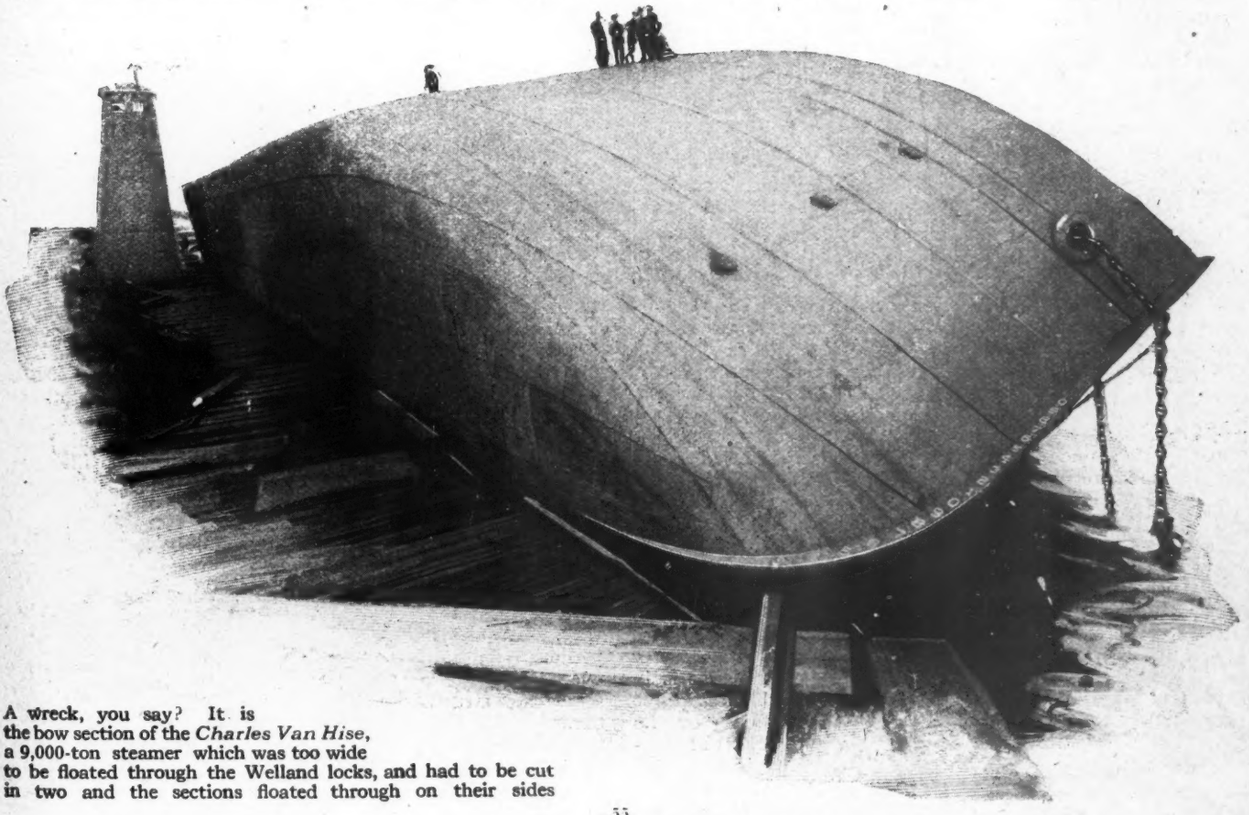
In addition to this total of 768 tons of water, 135 tons of equipment was used as ballast. Since the pontoons weighed 105 tons, the grand total of 1,008 tons was required to turn the forward section, weighing 1,700 tons. The water and other ballast made the boat float with a draft of fourteen feet.

The turning operation was done, not in the locks, but in Lake Erie near Buffalo. The bow section was first towed upright to a suitable place. Then the pumps were started, steam being furnished by accompanying tugs, and after five hours the tanks and pontoons were filled, whereupon the section rolled over perfectly on its side. It was then towed back to Buffalo, where leaks and other minor repairs were made. This done, it was towed to Port Colborne, the entrance to the canal. In the spring it will go on through the locks.

Getting the Stern Through

The stern section will be floated through in a similar manner. It was first planned that the two sections should be righted before being joined together again. But now the engineers, F. A. Eustis, H. N. Herriman, and W. F. Powers, hope to join the two halves as they lie floating on their sides, and without putting them into dry-dock.

First of all, they will calk and paint that portion of the vessel that is out of water; then they will roll her over, remove the pontoons, shift the ballast, and complete the other side in the same manner.

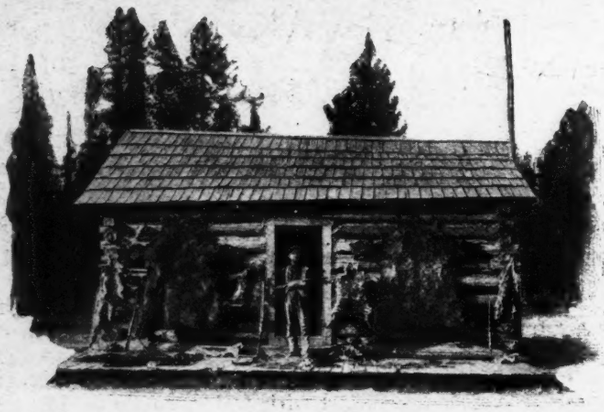


A wreck, you say? It is the bow section of the *Charles Van Hise*, a 9,000-ton steamer which was too wide to be floated through the Welland locks, and had to be cut in two and the sections floated through on their sides

On the Trail of the Wolf and the Grizzly-Bear

GRIZZLY-BEARS, lions, wolves, bobcats, and coyotes are very popular in the zoo, and in the zoo only. For in their natural lives, roaming around the mountains, they are merciless murderers, killing cattle and sheep.

At the cattle-raisers' cry for help, our government declared war on these marauders, and in the last three years government hunters have killed 70,713 animals. This has resulted in a direct saving of more than five million dollars a year to stockmen in the Rockies. Figuring from the number of cattle saved and the number of cattle-killers killed, it has been estimated that each wolf kills about a thousand dollars' worth of cattle a year, each bear and each lion five hundred dollars' worth, and each bobcat and each coyote fifty dollars' worth.



Not only is money saved by these killings, but it is also made: for the fur from these animals is very valuable. Last year the income from skins was approximately one hundred thousand dollars. Some of these skins are shown here hanging outside of the log cabin of one of the government men. The hunter himself is standing in the doorway.

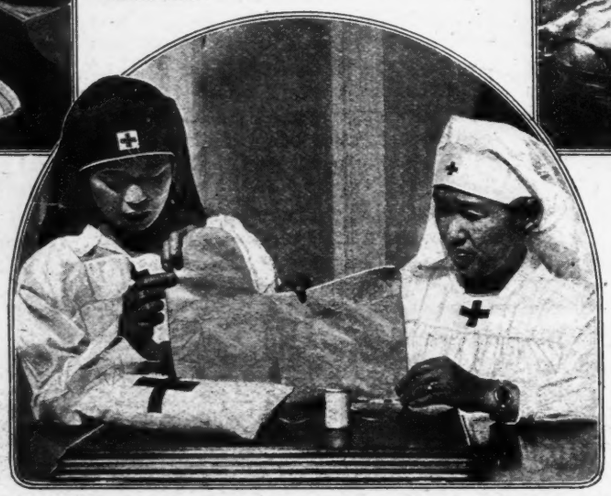
Trying It on the Rabbit

THESE three men in a boat are not banishing forever from the land the two innocent rabbits with ribbons round their necks. The rabbits are simply going to act as passengers in the small white life-boat alongside.

This life-boat has a passenger-car suspended within, which is so attached that it retains its horizontal position regardless of the roll of the boat.

The Sensible Socks of Japan

JAPANESE women made socks for their soldiers in a way that was far less expensive than ours, and much simpler. They made them out of paper. Paper, if you stop to think of it, has a reputation for keeping in the warmth of the body. These Japanese socks were of thick, heavy rice paper, made in a single piece, shaped like a baby's sock. They were worn for only a few days and then discarded.



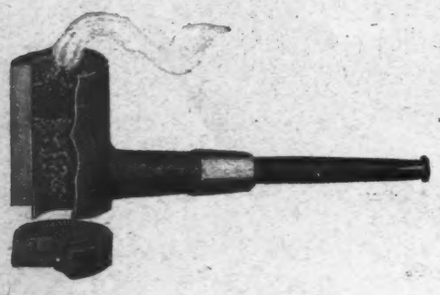
He'll Soon Be in the Soup

THIS great sea-turtle was taken by fishermen off the southern California coast and towed into San Pedro, the port of Los Angeles. The creature weighed 428 pounds, and furnished steaks and soups for hundreds of patrons of a café.

It was the largest turtle ever caught north of Mexican waters in the Pacific. Boatmen found it basking on the surface of the water, and harpooned it.

The Bottom Drops Out of This Pipe

ECONOMY, ease, and enjoyment all congregate in this new pipe whose bottom drops out that tobacco may enter. If this pipe goes dead when only partly smoked, you take off the bottom, poke the tobacco upward till all the dead tobacco drops out of the top, fill it up from below with fresh tobacco, put back the pipe bottom, and light up. This flow of tobacco eliminates the waste that usually accompanies filling up. Then, too, the old tobacco which is now on top in the pipe has been dried out by the heat of the former smoke, and lights up easily.

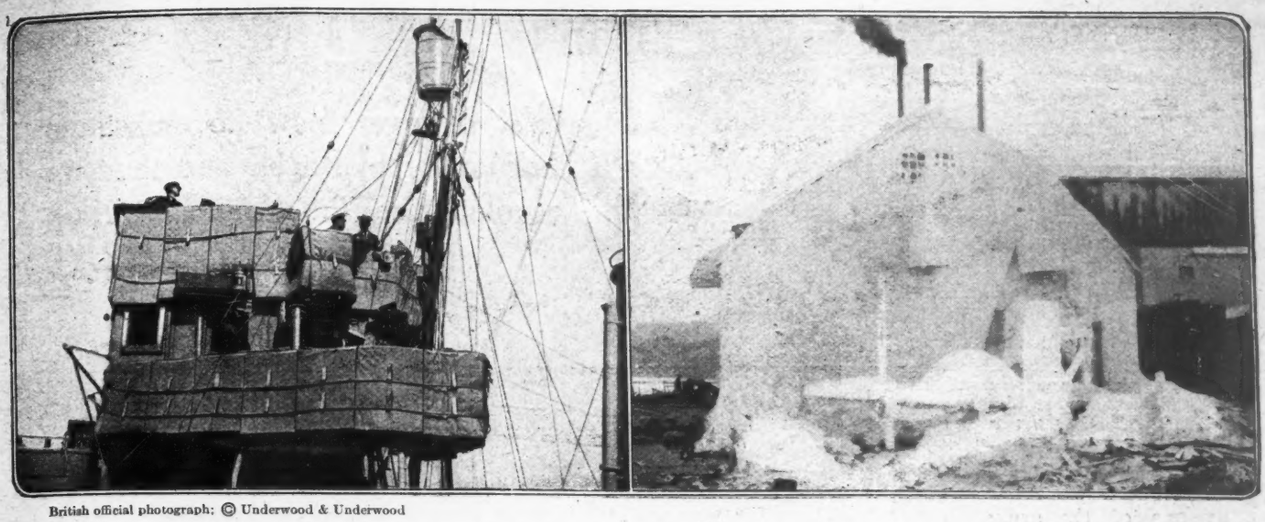


The illustration shows plainly how snugly the bottom fits on the pipe. This close fit makes the connection air-tight, so that the efficiency of the pipe is in no smallest degree hindered by its piecemeal construction.

When Bullets Meet in the Air

SO many bullets flew through the air in both directions, in large battles of the Great War, that some of them were bound to bump into each other. When a German bullet and an English bullet met, what happened? They fought it out to a finish right there, and fell to the ground interlocked. A pair of fighting bullets were picked up by an English soldier one day after he and his comrades had pushed the Germans back several hundred yards. The bullets are shown to the left in the illustration. The English bullet, of course, is the upright one, the German bullet badly bent.

The bullets pictured on the right show even greater signs of having been through the war. In their perilous journey over No Man's Land they struck barbed-wire entanglements, with the results shown.



British official photograph; © Underwood & Underwood

If the King Had Stood upon the Bridge

IN those far-off days when Zeppelins flew over England and submarines infested the English Channel, King George decided to look things over in France. His faithful subjects were nervous lest harm befall him on his trip, and so they put on the ship that was to take him over several safety devices.

The picture above shows one of these devices — padding tied around the bridge to protect it from shell splinters. This was certainly the height of precaution, for the German navy that was did not have a reputation for being venturesome, and there was little chance of its attacking anything larger than a motor-boat.

But if King George had happened to be on the bridge — as he is in the illustration — when an attack was made, flying bits of steel would have embedded themselves in the padding instead of in the King.

This Salt-Refinery Is Its Own Advertisement

HAD Hans and Gretel been salt-lovers, they would have joyfully pounced on the house shown here, for it is salted inside and out. It is a refinery near the Great Salt Lake in Utah, and its salty coat is caused by some of the damp salt, on its way in, sticking to the outside and hardening there when dry, instead of going inside to get refined.

When the salt on the shores of the lake is about six inches thick, it is harvested with regular farming machines. Plows dig it up, and the salt farmers load it on wagons, and then send it to refineries.

When the refineries get through with it, the product emerges as either table, dairy, meat, ice, rock, or pickling salt. Sieves and strainers decide which is which.

We must thank Great Salt Lake for keeping down the price of salt. Too bad sugar doesn't come that way.

A Boys' Dirigible Balloon with Parachute

A WESTERN novelty manufacturer offers a toy balloon consisting of a six-and-a-half-foot bag of strong tissue paper, two inflating cartridges, one tissue parachute with a cardboard dummy, two sets of time-fuse, and directions for the use of the toy.

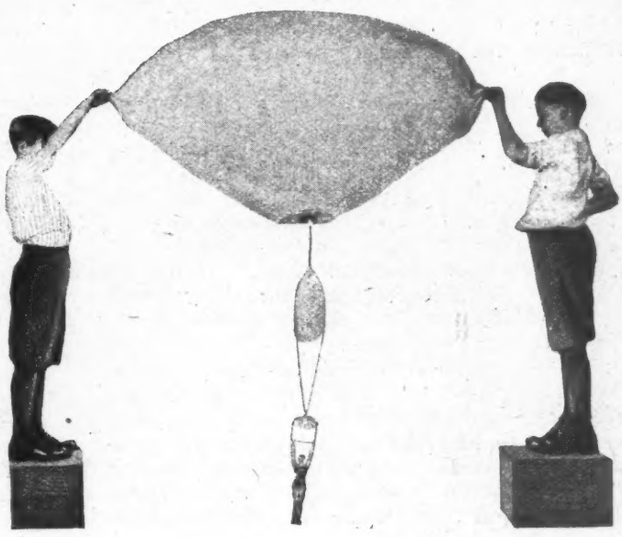
To send up the balloon, the bag is first loosened, then the lighted inflater is inserted in the bag. Before burning itself out, the inflater will carry the balloon to a considerable height.

The parachute is attached to the balloon by a time-fuse, which will burn when the inflater is burned out, thereby releasing the parachute with the dummy. The balloon may be recaptured and sent up again with the extra inflater.

Use This Table instead of Your Lap

THOSE of us who are versed in the latest developments of Hawaiian habits know that in order to be truly up-to-date you must get a steel guitar; and a steel guitar must be held in a horizontal position when played.

This is quite inconvenient, since one's lap, the only horizontal resting-place one has, is too far down to serve efficiently. Therefore a thoughtful man has invented a guitar table. The table, which glides on casters, is hinged to the chair in which the player sits. When he wishes to play, the musician swings the table with the guitar on it in front of him. When he gets through playing, he pushes the table back.

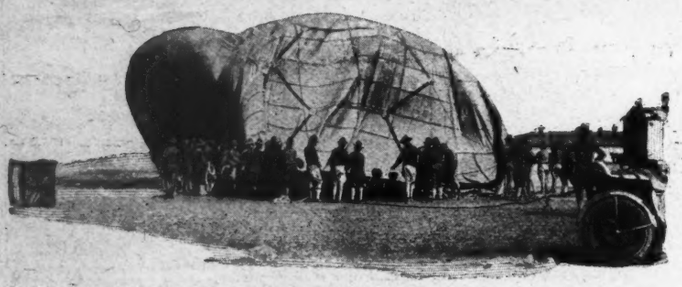


Looks Like the Smallest Statue of Liberty

WHEN the Statue of Liberty came from France to settle down in New York Bay, she was so large that she had to be broken up into 300 pieces, and shipped in several loads. Then, when the last of the 300 pieces had arrived, she was slowly reassembled. But in the small copy of her shown above all these complications are eliminated.

This one-pieced statue lives, not on an island, but on a white-enameled box in which is concealed a battery. The battery is connected with the lady's torch, and may be lighted by pressing a button. Since stand, statue, and battery are all in one, moving-day for this small lady is a very simple matter.

Balloons that Can't Catch Fire



The balloon was behaving badly when this picture was taken at Fort Sill, Oklahoma, and so the bag was deflated. Then, as the other picture shows, something happened

We discover how to substitute helium for hydrogen and thus we revolutionize the dirigible airship

By Albert Whiting Fox

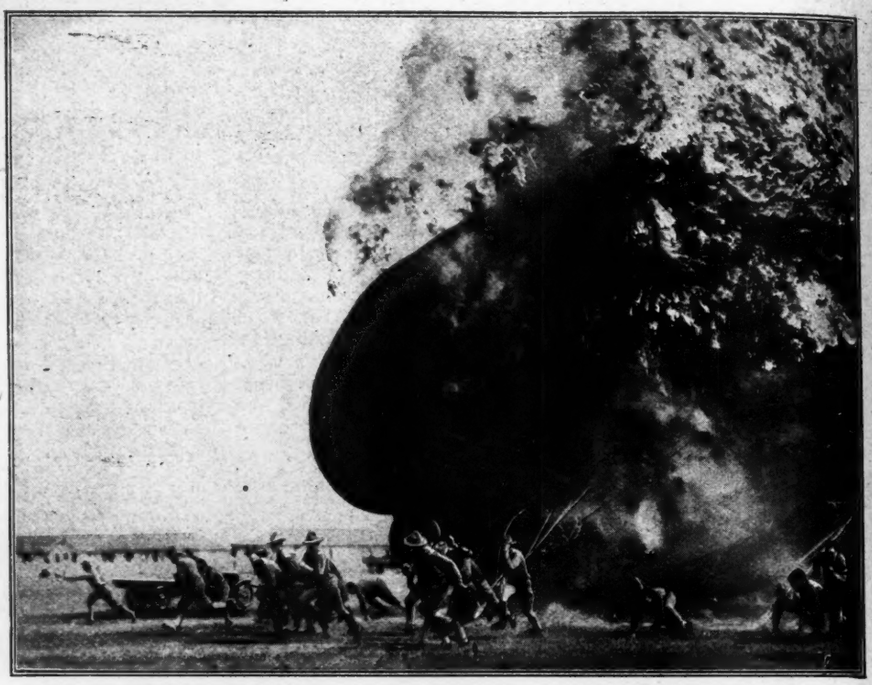
IN a recent test of marksmanship at one of the army aircraft schools, two small balloons were provided as targets for two respective groups of marksmen. At the first shot from the first group the target burst into a mass of flame and smoke—the effect of an explosive bullet. The second group fired once, twice, a dozen times. Observers were sure that some of the shots had scored hits—but nothing happened. The firing continued, with the same negative result. Something was wrong. The explosive ammunition was pronounced defective. Report to this effect was made formally to the proper authorities.

Why It Didn't Catch Fire

Only a few officers present knew the secret. The test was camouflaged, in the sense that the second balloon could not have been set afire by any known agency. It contained the new non-inflammable gas developed by the government and guarded as an all-important war secret. This gas—helium—is now being produced in large volume. Its value for peace and war usage is regarded as tremendous. The story of its development from the inception of the idea to its practical usage has all the elements of romance of the middle ages.

It might truthfully have been said to the disappointed army marksmen: The reason you don't explode that balloon is because a Professor Cady, of the University of Kansas, some ten years ago made a survey of the gas and oil resources of that region, and published a scientific paper, which happened to be in the files of an old British scientist in London at the time one of the Zeppelins was brought down.

"Suppose the gas would not burn?" the professor thought. He recalled having seen the report of an American professor, illustrated with so-called iso-helium lines to outline the region where he thought helium existed. The British scientist knew, of course, that helium was non-inflammable, and light enough to lift a balloon or Zeppelin. He put two and two together in the quiet of his study, and wrote a note to the British Admiralty. That was the beginning.



A company of terror-stricken men fled for their lives when a great hydrogen-filled observation-balloon caught fire at Fort Sill, Oklahoma, during inflation. How did the fire start? An electric spark passed when the folds of the bag were rubbed together. It was the same kind of spark that you obtain when you rub your feet on the carpet and light the gas by touching your knuckle to the burner. When non-inflammable helium is used, instead of hydrogen, there need be no fear of such accidents

Fascination of Helium for Scientists

The Admiralty turned the note over to the proper scientific branch as a matter of routine. Ideas from outsiders came by the thousands, but this one attracted attention, chiefly because helium had a fascination for the British scientists. Its characteristic line had long been a feature of the sun's spectrum. But the gas itself had never been isolated on the earth.

It seemed for a time as if helium would never be obtained. Then Ramsay and Rayleigh got hold of the residue of several tons of liquid air that had gone through the Claude plant in Paris, and fractionated it, discovering unknown constituents of the air (argon, xenon, krypton) and—helium. There on the spectroscope was flashed the long-lost helium line! More light was shed on helium when it was found to be a constituent of radium emanation. Radium and helium are elements. Radium was being transformed into helium! Were the old alchemists right, after all?

Professor Satterlee, of the University of Toronto, made some investigations that led him to suggest the possibility of helium's being the product of radioactive transformations under the ground.

English and Americans Collaborate

The Admiralty took the position that, if there was one chance in a thousand of getting helium in quantities, it was worth taking. Professor Satterlee was requested to consult the American authorities and to investigate Professor Cady's report.

The hydrogen with which balloons are inflated is contained in steel bottles under high pressure. It is thus that helium will be bottled

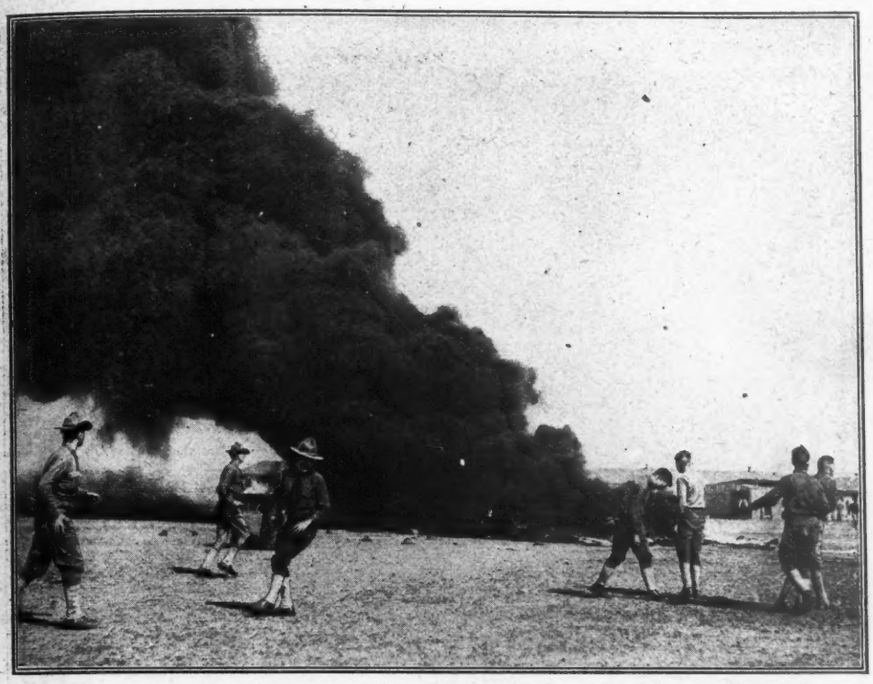
About this time the United States came into the war, and the British sent over experts to collaborate with Colonel Burrill, technical head of our Chemical Warfare division. He, in turn, took the matter up with General Squier, then head of Army Aeronautics, Director Manning of the Bureau of Mines, and Admiral Griffin, Chief of the Bureau of Steam Engineering in the Navy.

Soon after the matter reached Admiral Griffin, there appeared in his office a Mr. Carter, who had given up civilian work to enter the Navy. It developed that he probably knew more about the liquefaction of air and gases than almost anyone else in the country. It seemed as if fate had pushed the right man at the right moment into Admiral Griffin's office.

The Army and the Navy engaged companies to liquefy the natural gases in the areas indicated by Professor Cady. Congress was asked to appropriate money for the production of argon. It would never do to let the truth leak out in the midst of a war.

Professor H. N. Davis took hold of the Army end, Commander Dyer represented the Navy.

Now there are two big plants producing helium in large quantities and another company about to begin, all located in Texas. Natural gas is collected and compressed and cooled down in the same kind of apparatus that is used to liquefy air. As the cooling process continues everything is liquefied out long before the helium. The regular hydrocarbon series, making up approximately 70 per cent of the natural gas, liquefies first, and then the nitrogen, constituting about 30 per cent, is condensed at a temperature of 195° C. below zero. It requires 268 degrees below ordinary zero (Centigrade) to liquefy helium, which is then collected for use in balloons. The amount of helium in natural gas is .95 per cent.



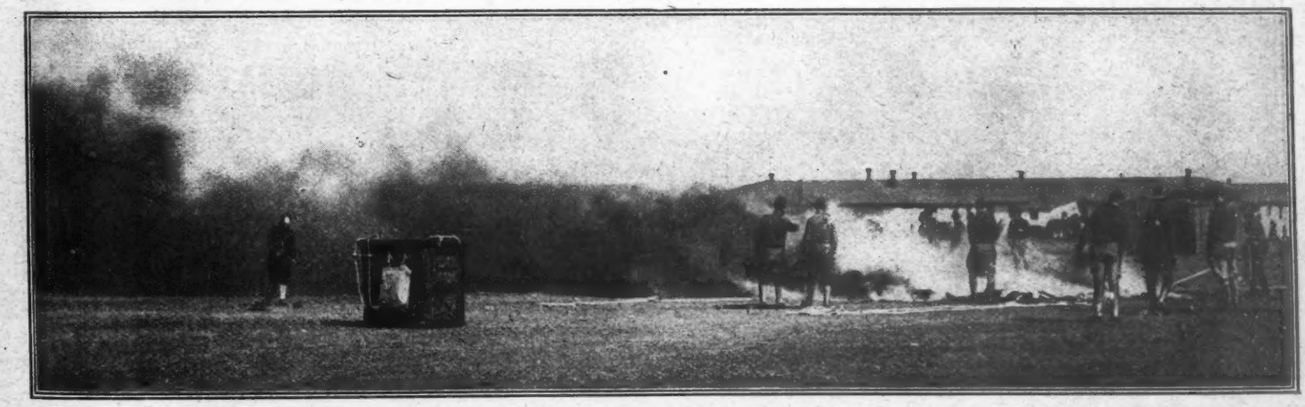
Here we have the third stage of the terrible balloon conflagration at Fort Sill, Oklahoma, of which the first two stages are illustrated on the preceding page. The picture tells its own story of men driven to flight and overcome by fatigue. Helium instead of hydrogen, as the inflating gas, would obviate such accidents

Had the Germans Known Helium

In a military sense, helium for balloons is the answer to the high-explosive bullet, just as armor in the old Navy was the answer to the guns that riddled wood. Had the Germans filled their Zeppelins with helium instead of explosive hydrogen, they might not have proved such failures as city bombers.

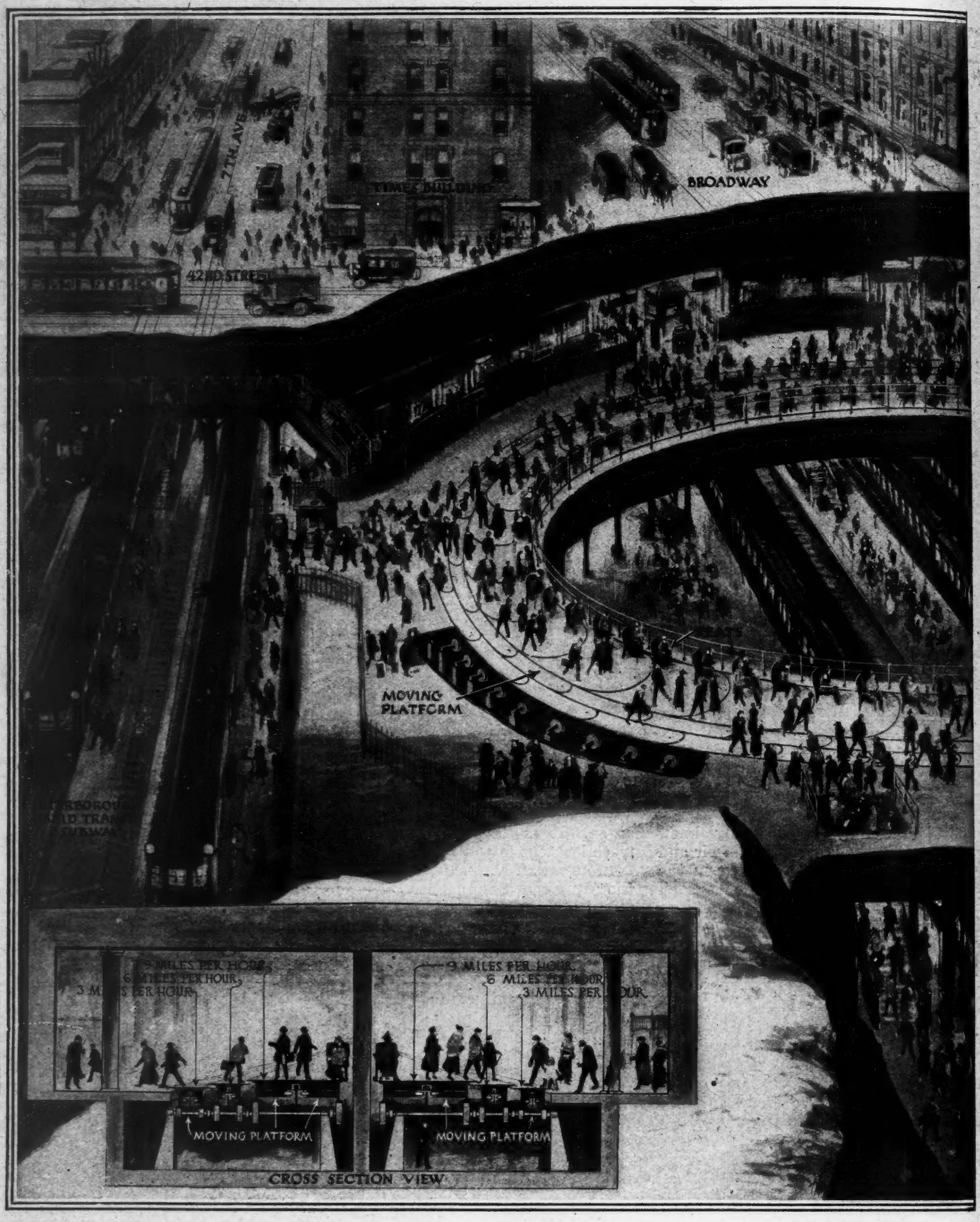
The entire art of designing and equipping dirigibles will be revolutionized. Electrical apparatus, heretofore barred because of the ever-present dread of sparks, may be installed, new types of motors may be used. A new field is opened up for development.

Why is there so much helium in Kansas, Oklahoma, and Texas? Probably because of the quantities of radio-active minerals. Helium, as we have seen, is a degradation product of radium.



All that is left of the balloon is the basket. As long as hydrogen—highly inflammable and, when mixed with air, violently explosive—is used to inflate bags, such accidents are inevitable. And now the government announces that it had made preparations before the armistice was signed to fill the bags of balloons and dirigibles with helium, which is almost as light as hydrogen, but which is not inflammable. It sounds like an alchemist's dream

And the Transportation Engineer Said:



NEW YORK has street cars, subways, and elevated trains, and still its millions of people find it hard to travel from one part of the city to another without fighting for a place to stand up in, much less to sit down. Sooner or later New York must come to moving sidewalks. It is an old idea, revived, with improvements of his own, by Hjalmar E. Skouger, a construction engineer.

Similar apparatus is now used in carrying half finished products from one department to another in factories, or in loading or unloading steamships and railroad cars. The moving platform for transferring human cargoes consists of short units of steel or wood, formed in an endless chain, and actuated by gearing beneath it. It may consist of three or four parallel sections, the first going at the rate of three miles an hour, the second at six, and a third at a speed of nine miles, or even a fourth proceeding at a still higher rate. Passengers step from a stationary platform to the first section, and go by scarcely perceptible stages to the fastest strip. When they wish to alight they return to the three-mile gait, which is about that of an ordinary walk. The platforms may or may not have seats for the public, as traffic conditions require.

Exits to the street above can be arranged at short intervals; for an underground line could be skirted by an arcade that would be a continuous station.

The distance to be covered in Forty-second street, New York city, 3,000 feet, would require approximately 6,000 feet of

"Let the Sidewalks Move"—And They Moved

moving platform. The main difficulty in installation would be in making turns at the terminals. Mr. Everhart Smith, inventor of the best known type of platform, says that this can be done in a circle with a radius of sixty-five feet, without encroaching on building lines any more than at present. His estimate is that the device can be kept in motion, even with many passengers standing on it, with about 200 horsepower.

The ten-car subway express trains are driven by motors capable of developing 2,000 horsepower, but no such energy is needed because of the heavy losses of electric current due to stopping the trains and starting again. This moving platform would be a continuous, non-stop train. If the platform stalled, the passengers could step off or walk along it to their destinations.

No conductors are needed, and one engineer does all the work. Inspectors stationed beneath the belts take the place of track-walkers. A few ticket-takers and -choppers would be required. All the engineering and operating points have been worked out for exhibition purposes with success.

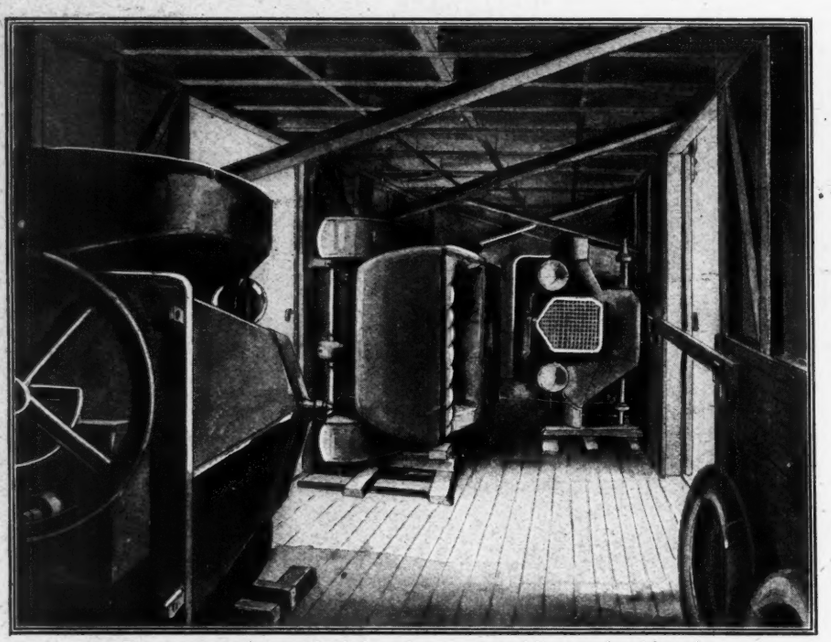
At the World's Fair, held in Chicago in 1893, a local company organized by Mr. Smith operated the first moving sidewalk, 4,400 feet long, which was ridden on often by 6,000 persons at one time. A second was installed in Berlin in 1896; while at the Paris Exposition in 1900 a third one, four and one half miles in length, was patronized daily for months by throngs of sightseers.

Four Automobiles to the Car

A new system of crating solves a problem in freight-car loading

THE problem of shipping automobiles has received a great deal of thought by those engaged in the industry, and yet there has always been the objection of waste space when the automobile has been finally loaded on a freight-car.

In loading automobiles on freight-cars, the number is limited both by the dimensions of the car and by the size of the opening through which the machines are inserted. With certain sizes of freight-cars, while there may be sufficient space for more than two automobiles, the size and position of the door limits the number to two.



By a new crating method three large automobiles can be shipped in a thirty-six-foot freight-car and four in the forty-foot type

To increase the loading possibilities, a new system of crating has been devised. The automobile is first jacked up so as to remove the front and rear wheels on one side, after which the crate is placed alongside and wired securely. Recessed blocks receive the ends of the axles and assist in securing the framing.

The next step to the loading operation is to turn the automobile on its side, with the side frame underneath. Suitable trucks are first placed nearby, so as to move the machine readily through the door of the car, the other wheels of the machine having been removed beforehand. Two machines are placed lengthwise of the car at each end, if the car is the forty-foot type, and even in the thirty-six-foot type three large machines can be conveniently loaded. To insure safe transportation, the load is securely braced.

Shipping automobiles is easy when you know how. It took a long time to learn, however, and much waste space was paid for during the experimental period.

Hauling Six Steers in a Truck with Capacity for Only Four

Thereby increasing the earning capacity of the vehicle

BY placing steers transversely in the truck-body instead of longitudinally, the farmer who owns the truck shown below is able to carry six animals in the same body that will hold only four if loaded in the ordinary manner. He thus increases the earning capacity of his vehicle fifty per cent.

It will be noticed that the animals are placed alternately, with the heads of the first, third, and fifth on one side, and those of the second, fourth, and sixth on the other. Thus the entire body space is utilized, the steers being wider at the rear than at the head.

The animals are kept in their place by locking their heads in rectangular rings pivoted at the top to the body sides and locked in place at the bottom. The body sides are removable, and, after the animals' heads have been removed from the rings, may be hooked on the side of the truck-body to provide a convenient unloading runway.

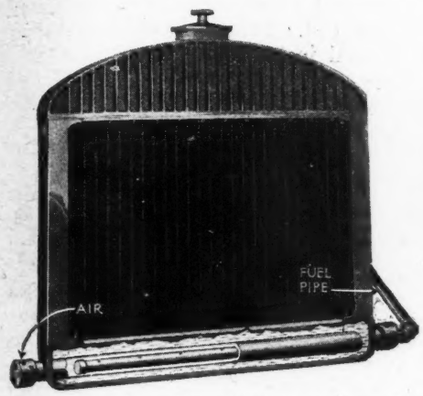
By fitting the steers in sideways, the truck will hold two more

How to Keep Your Truck Radiator from Freezing

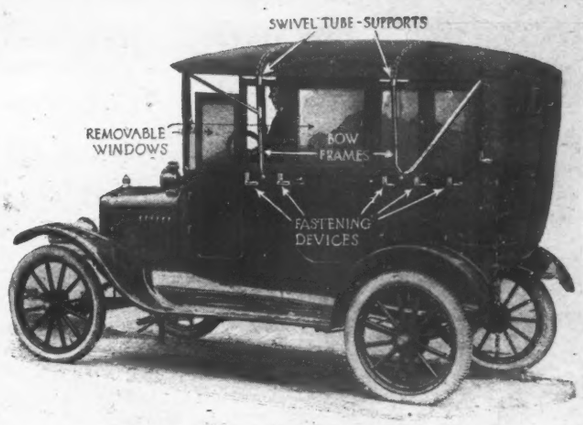
ANTI-FREEZING compounds of various combinations have been tried with partial success, but it remained for W. Bonson, of Altrincham, England, to patent the simple device shown below. It is made by fitting a tube of about 1-inch or 1½-inch internal diameter crosswise inside of the bottom tank of the radiator.

The tube is open to the air at both ends, and is made water-tight by brazing into the ends of the tank. One end of the pipe is threaded and covered with a cap having small holes to admit air to the inside of the tube from that end. At the center of the tube at the cap end is screwed a second smaller pipe which extends along the inside of the first tube for almost its entire length. The inside tube is attached to the acetylene tank used for lighting or to the fuel tank.

Whenever the truck has to be parked when the temperature is below the freezing-point, the fuel or acetylene valve is simply opened and the inside tube filled with gasoline or acetylene gas, which is lighted with a match. The air required for combustion comes from the ends of the open tube, and the heat given off keeps the water hot. While the device was originally planned for war trucks, it can be applied with equal success on commercial motors, where a frozen radiator is apt to mean cracked cylinders.

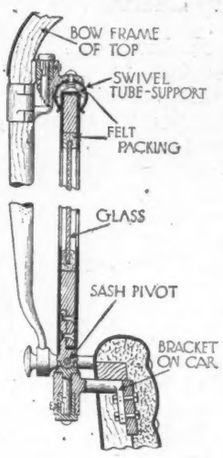


A tube in the radiator is filled with gasoline and lighted to keep the water from freezing



Detachable side windows have turned this old touring car into a comfortable limousine

Detachable Windows for Old Cars—A Cold-Weather Comfort



OWING to the curtailment of automobile manufacture, your car may be worth as much as you paid for it and it may pay you to provide it with modern conveniences. E. A. Armstrong, of Highland Park, Ill., has patented detachable side windows, obviously preferable to the ordinary side curtains.

Each window is inclosed in a metal sash. The sashes in the way of the doors are fastened to the doors, while the others are fixed in place, although free to weave or move as the top moves because of the car's vibration.

First Loaded Truck Trailer Over the Alleghenies

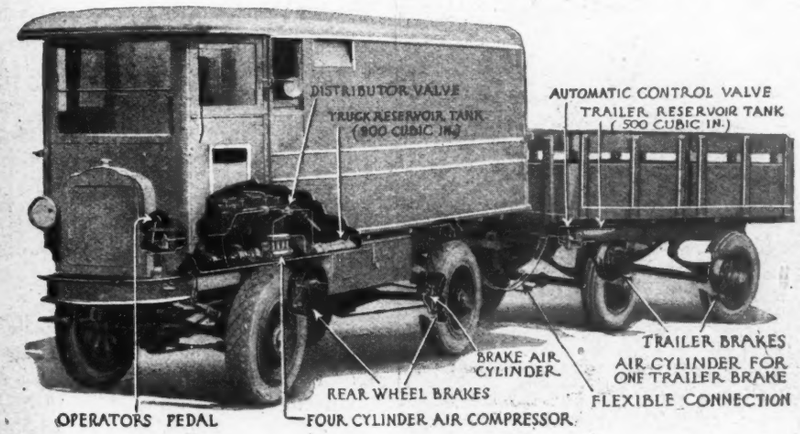
THE first loaded motor-truck trailer ever hauled over the Allegheny Mountains early in December completed a round trip between Akron, Ohio, and Boston, Mass., a distance one way of 740 miles.

Motor-truck haulage over the roads between Akron and Boston began early in 1917, and has continued ever since. Several attempts had been made to employ trailers in the work, so that the tonnage carried per trip could be increased to five or eight tons to reduce the cost per ton hauled. However, these had to be given up, because the trailer could not be held in place when descending the long steep grades.

The trip was finally made possible by equipping both the tractor and the trailer with a new type of pneumatic air-brake which permitted the outfit at times to coast down some of the steep grades at a speed of over thirty-five miles an hour, with the trailer in complete control.

The brake equipment is the invention of A. L. Parker, of Cleveland, Ohio. It consists of a small four-cylinder air-pump driven from the engine; a reservoir tank on the tractor; another reservoir tank on the trailer; a distributor valve; an unloader valve corresponding to a safety valve on a boiler; and the necessary piping and flexible connections between the tractor and the trailer.

This flexible connection is carried along the draw-bar, so that it does not interfere with the operation of the outfit when rounding corners.



Pneumatic air-brakes on both tractor and trailer insure safety on steep grades, making it possible to haul freight over mountain roads

A mass of highly polished minute steel balls and pins, rolling and tumbling over the silverware, cleans and burnishes it

Keep the Silver Shining

HOUSEKEEPERS with even a moderate collection of silverware find it difficult enough to keep their family silver in presentable condition. In clubs, restaurants, and hotels the task of keeping the silver clean and well polished presents a serious problem. Chemical baths for the removal of tarnish, and the frequent use of the scratching-brush and buffing-wheel, together with chalk or some other detergent for restoring the polish which adds so much to the attractiveness of the service, are effective, but require much time, labor, and expense, and soon wear off.

Occasional reburnishing will keep the silver bright, but it requires a great deal of time and is entirely too costly a remedy. In burnishing, the metal surface is rubbed with special tools of highly polished steel. The silver is given what may be called a massage, which hardens the surface and at the same time imparts to it a high polish. The work is mostly done by hand, and requires highly skilled workmen.

A machine for burnishing silver, the invention of a Swiss citizen, is now extensively used in many large hotels, restaurants, and club-rooms. It is so simple that even an inexperienced person can operate it successfully.

The silverware is placed in a cylinder immersed in a soap solution and containing a quantity of small steel balls and pins. The cylinder is slowly rotated by a motor or any other suitable source of power. As the cylinder turns, the minute balls and pins, each constituting a small burnishing tool, slide, tumble, or roll over the silver, removing all tarnish and dirt, and imparting to its surface that high gloss and finish which only well burnished silver will show.

The small balls and pins are of several sizes, and as they roll over the silver they reach every corner and every crevice of the most delicate ornamentation. The surface of the silverware is cleansed as thoroughly as if a scratch-brush had been used, but there is practically no abrasion. Ten per cent of the silver is lost every year in using the scratch-brush and buffer.

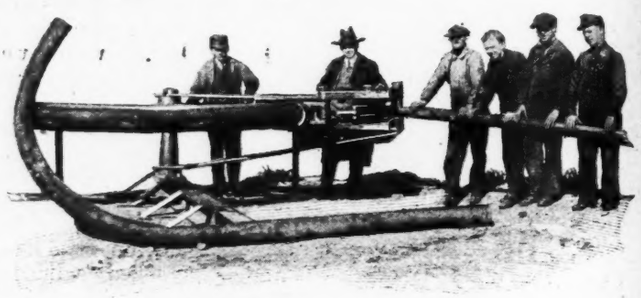
It Bends Cold Pipes Like Wax

TO BEND a six-inch wrought-iron pipe without the use of heat would have been considered impossible a few years ago. Now, however, with the assistance of one of the powerful devices shown in the picture below, pipes of a diameter as large as eight inches can be bent. It took nine and one half minutes to give to the six-inch pipe in the foreground a right-angle bend. The pipe was bent in the cold state. It would have required several hours' work to perform the same task by the use of heat.

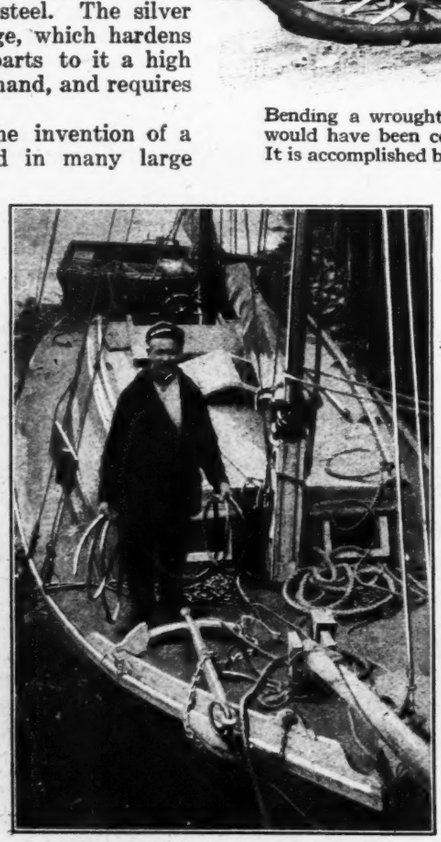
The device consists of a large iron wheel, provided on its periphery with a groove snugly fitting the diameter of the pipe. By means of a powerful toggle-joint lever, operated by four or more men, the pipe is pressed against the grooved curve of the large wheel.

The pressure produces a barely noticeable bend at the point of attack; but, as the position of the pipe is shifted and the pressure of the lever applied at a point a short distance from the initial point of attack, the curvature of the pipe increases rapidly. The work is completed when the ends reach the desired angle.

If the curved pressure plates of the bending device are applied judiciously and at short intervals, an almost perfect curve can be produced. In some bending-machines, hydraulic pressure is used instead of a toggle-joint lever; but experience has shown that the work can be done more quickly and satisfactorily with a lever device operated by man-power..



Bending a wrought-iron pipe without heat—a feat that would have been considered impossible a few years ago. It is accomplished by pressure applied by a large iron wheel



Another exploring Drake. He built his boat himself, and sails it single-handed

The Cook, the Crew, and the Captain Too

ENGLAND has produced another exploring "Drake." This one, named Thomas, was living in Seattle, Washington, and was fifty-five years old, when the roaming desire seized him. He immediately built a five-ton auxiliary schooner, 32 feet long, 10 feet beam, and 3 feet deep. It carries 750 yards of canvas and a 5-horsepower engine.

When the boat was finished he named it *Sir Francis* after the Drake of Elizabethan days. He might well have named her the *Nancy Bell*, for he sailed away all alone, his own captain, crew, and cook.

Alone in this small boat, he cruised down the coast of California and through the Panama canal, landing when the spirit moved. Then he came up the Atlantic coast as far as Maine. And in this way he hopes to travel the world over.

Riveting? Do It Electrically

By F. W. Fitzpatrick

THE pneumatic riveter was a great invention. It expedited steel assembly work. But why do we still heat the rivets on a forge fire? And the heater, why must he toss the heated rivet to a man twenty or thirty feet away from or above him, who must deftly catch it in a bucket? Why must the rivet be handled again, placed in the rivet hole, held in position while the riveter is set to work upon it, the rivet chilling every moment?

I want to see the riveter place the rivet in position cold. On his pneumatic machine would be a spring device that would hold two or more carbons in electrical contact against the protruding rivet. The plunging or hammering function of the riveter machine would not in any way disturb the contact, because the spring part is attached to the hand part of the machine or the portion that is not in action. The wire would be attached to the riveter, and the other pole wire to the dolly-bar or some solid "backer" against which the riveting is done.

Naturally, there are details to study and difficulties to overcome. The current requisite to heat the rivet to the right point, the resistance, and such matters must be determined.

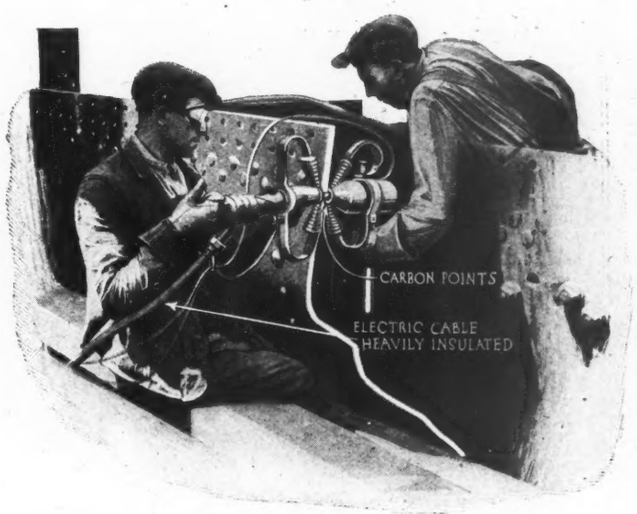
Provision must be made for the protection of the operators, for relaxing the spring so as to remove contact for the last few finishing strokes, and for the best form of contact, which will have to be carbon, as far as material is concerned.

Electrical driving would keep the rivet hot to the very last. The metal would be more malleable and would fill every unevenness of the hole. The percentage of poor riveting would be negligible.

The points of contact are so close to each other, and the rivet is of so different a quality from the plates, that the current would naturally flow directly to the spot where it is wanted.

Electrical heating will make a rivet so hot, so plastic, that I doubt if a riveter or hammer will be necessary. Simply heat the rivet to the right temperature and force it into position and shape. A sort of compressive action will be all that it will need.

Electric riveting would mean comparatively little cost for current, infinitely greater speed, much better work, and the cutting off of two men to every machine.



"I want to see the riveter place the rivet in position cold. On his pneumatic machine would be a spring device that would hold two or more carbons in electrical contact against the protruding rivet"

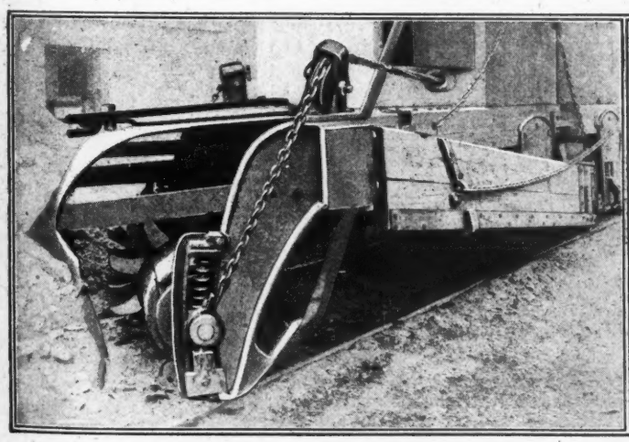
A Spiked Snow-Plow for Icy Days

THE snow-plow of former days was ineffective in severe winters when the extreme cold turned the snow to ice, and an ordinary broom snow-plow would not clear railroad tracks. An ice-cutting snow-plow has been invented which plows its way through ice, and may be easily attached in place of the old one.

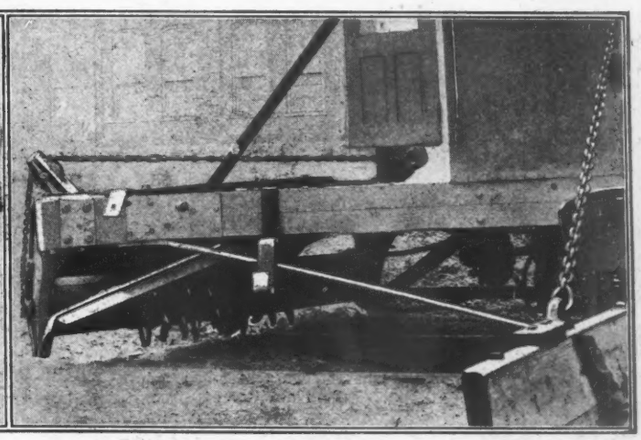
Three malleable-iron brackets are fastened to one end of the underframe where the plow used to hang. An eighteen-inch cutter-spindle with teeth attached replaces the rotary broom of old. Coiled springs over the bearings resist the upward thrust of this spindle.

The cutters on the spindle are of steel, eight inches long and an inch thick. They are hardened at the lower end for about one half their height. These teeth are placed on three split collars on each drum. There are seventy-two teeth in all.

The spindle is raised and lowered by means of chains. A jack-shaft mounted in the axle bearings, which is geared to the driving motor on the floor of the cab, drives a counter-shaft, which in turn drives the cutter-spindle.

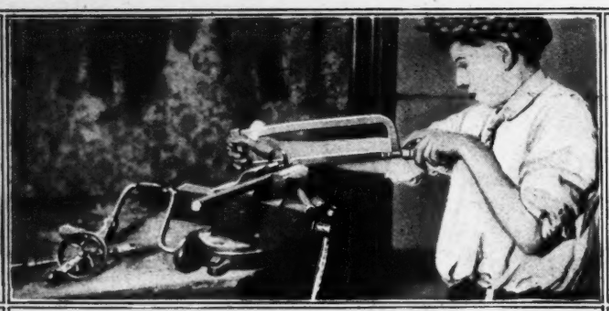


The teeth on the cutter-spindle plow through the ice on the tracks; this is a feat impossible to the ordinary broom plow



On this new type of snow-plow, a chain raises the spindle from the ground when there is no ice to cut

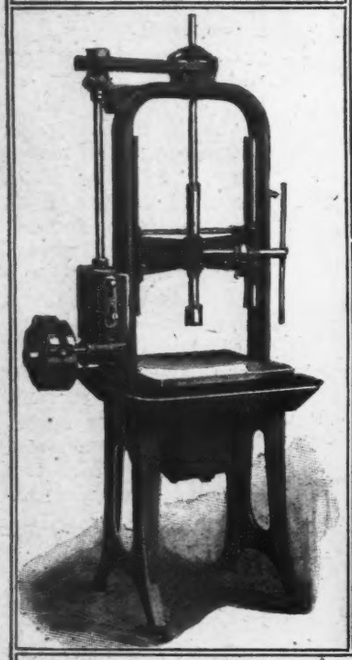
A saw set having operating handles that are so arranged as to enable the operator to assume a comfortable position



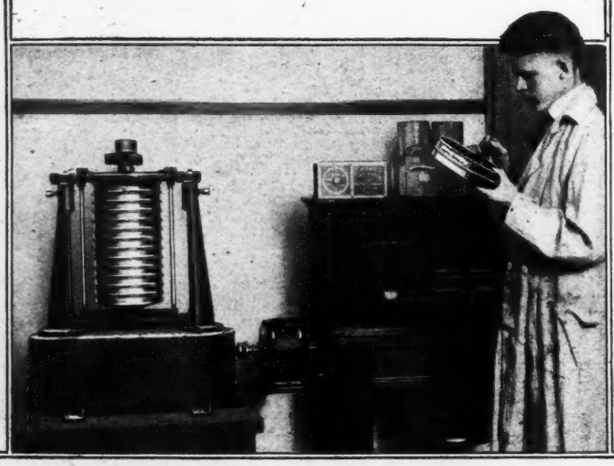
A device, easily carried in the pocket, which fits inside jaws of an ordinary vise for clamping pipe

This planer combines a level protractor with a planer, thus producing automatic checking of correct angles while planing

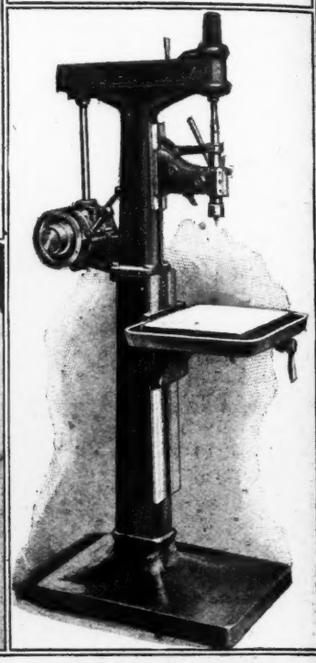
Things Machinists Ought to Know About Their Tools



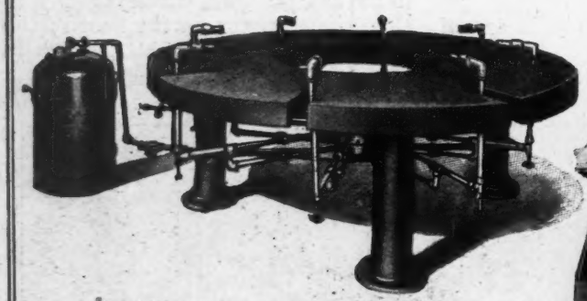
Rigidity, accurate drilling, front control, and ease of operation were the features kept in mind by the designers of this driller



Making twenty-eight fineness tests of cement in a little more than an hour, this machine is a great time-saver

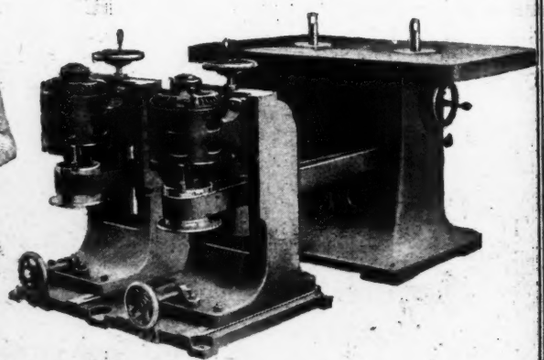


A high-speed drilling-machine manufactured upon safety-first principles in order to make possible its operation by women



The removal of giant locomotive tires is simplified by the use of this machine, which burns vaporized kerosene and is adaptable to all sizes

This parcel-tying machine ties from twenty-five to thirty packages a minute



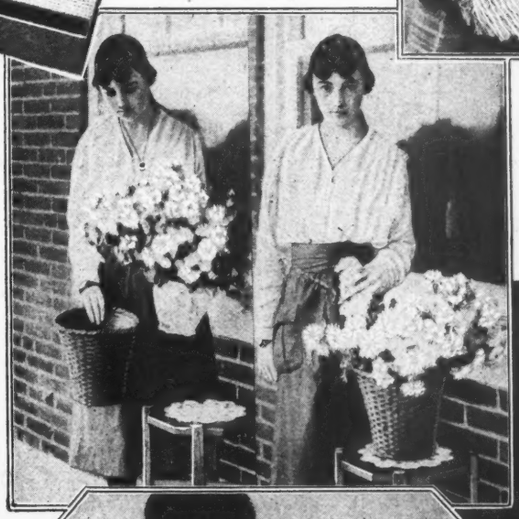
A new and compact motor drive for double-spindle shapers, using standard vertical motors that are independently adjustable to suit the length of belting

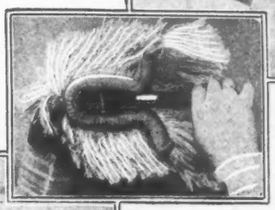
The appliance is about a foot square and attaches to any electric light socket

Several Useful New Ideas for Housekeepers

Hot, dry air will take water wherever it may be found—from furniture, house trimmings, and floors. To keep these from separating and showing large cracks, moisture should be added to the hot air. This radiator humidifier does the trick

The attractive wicker basket shown below is so shaped as to envelop completely a growing plant in its pot, producing the appearance of cut flowers in a basket



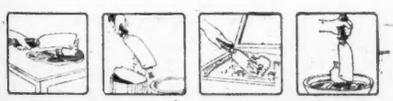


A knife-sharpener in the form of a reel strap which pulls down when in use

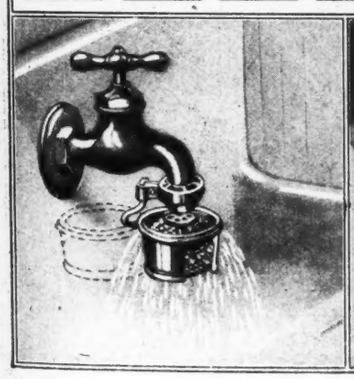
This duster-mop has fingers that reach under radiators or other places difficult to get at

A metal chair with a box placed on the lower rungs holding working tools; it may be used in stores, factories, or even the kitchen

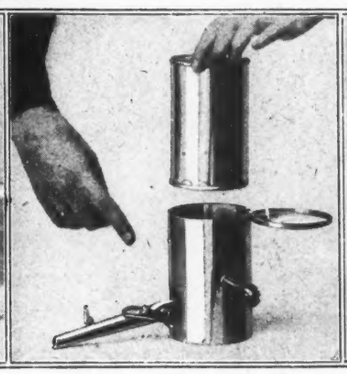
Heat for the gas oven or grate may be regulated for any length of time by the device shown at the end of the stove in the picture above



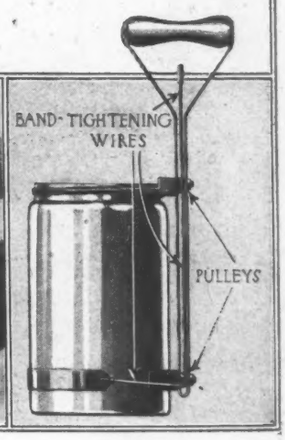
At the left and above is shown a combination device for use in various ways in the kitchen



A faucet receptacle for soap. It swings aside when not in use



When the condensed milk can is inserted in this retainer, the spout pulled up punctures the can, making it ready for instant use



A handle for lifting preserve jars out of boiling water

You Can Read Her Service Record on Her Stack

EVER since steam first went to sea and smokestacks began to rear their heads in the proud company of masts, sailormen have used the funnels of their ships as bulletin-boards to record rank and class. The skipper of a rusty tramp, sighting one of the aristocrats of the sea, could say, once his glasses had picked up the mark on her funnels, "There goes a Cunarder," or "Yonder's one of the new White Star boats"; while, like as not, even the stack of the tramp freighter bore some emblem to tell the world afloat whence she hailed.

Tramp or liner, no ship ever floated that was not loved by someone, and this affection for peace-time craft is intensified in the case of fighting-ships. The mere landsman may look upon a ship as just so much inanimate iron, wood, or steel; but to the sailor she is as much alive as any other lady. He may stand for a slight on his own appearance or performance, but, as you love peace, don't try to belittle his beloved craft.

The latest thing is service stripes for ships. The *Cassin*, having spent a year in foreign waters, sports two gold service chevrons on her stack, just as her crew —from chief officer down to the least deck-scrubber— wear the same sign.

© Kadel & Herbert

(*Above*) Sifting the sand at Coney Island for jewels
(*Below*) Showing results of one day's beach mining

Treasure in Coney's Sands

FOREIGNERS coming to America expect to find the streets paved with gold. So we pacify them by offering the golden sands of Coney Island. For each year, when the cold winds send the bathers home, the sands are full of things they have lost.

An enterprising native who owned an ash-sifter decided to try his luck. He started one morning and panned all day, filling his sifter with sand and then washing it in the waves. When the day was over he had collected in his sifter fourteen dollars worth of money and jewels.

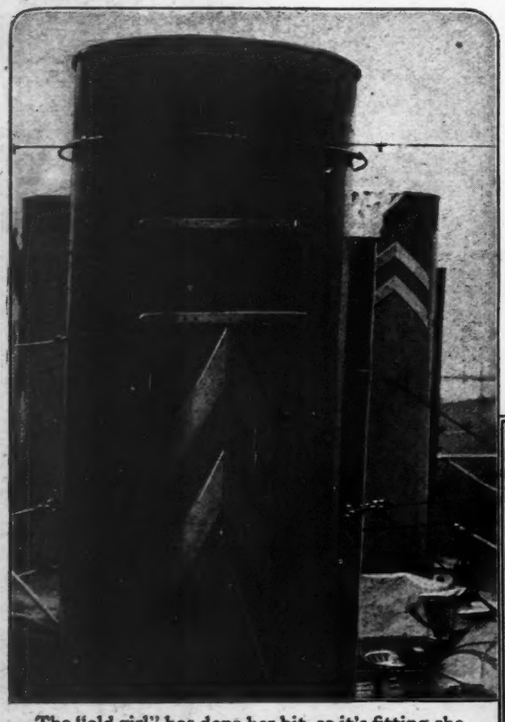
Bell Vibrations Helped Wreck a Tower

A STRIKING illustration of the destructive power of vibrations is given by the events which led to the removal of the tower of the Los Angeles City Hall recently. The City Hall was built in 1888, and had a tower 183 feet high and 26 feet square. For many years a large fire bell hung in the top part of the tower, and the vibrations caused by the frequent ringing of the bell wrought havoc with the masonry and would undoubtedly have led to its collapse. After a heavy rain-storm the tower listed heavily and pieces of the coping and the stonework crashed to the pavement. An investigation disclosed its condition as unsafe.

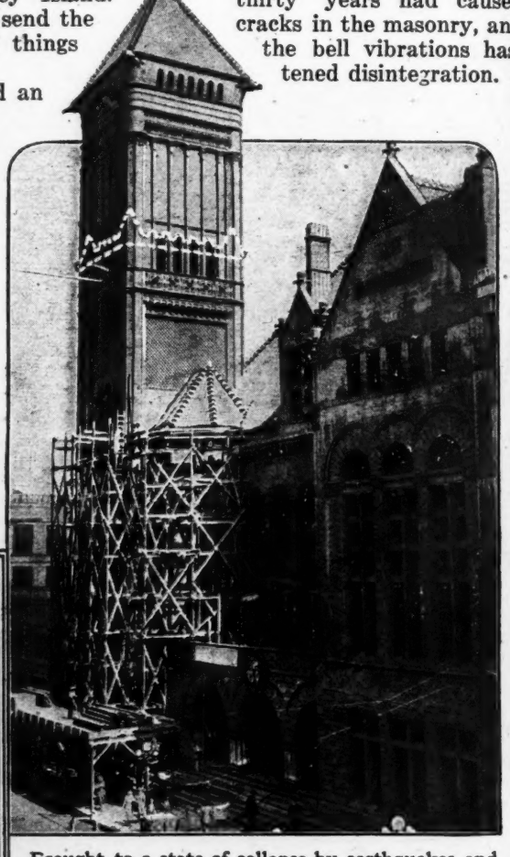
The vibrations of a big bell are far-reaching. When the clapper strikes the bell the vibrations cause the surrounding objects to vibrate in sympathy. Wood is very elastic and is not materially affected, but masonry possesses practically no resiliency. If there is any weak spot in the masonry, the work of destruction will be hastened by it.

That is what happened to the bell tower of the Los Angeles City Hall. The earthquakes in the past thirty years had caused cracks in the masonry, and the bell vibrations hastened disintegration.

© International Film



The "old girl" has done her bit, so it's fitting she should display the service emblem on her stack



Frought to a state of collapse by earthquakes and bell vibrations, the top of this tower had to be cut off

What Happened to the "Cyclops"?

If not sunk by the Germans, what might have happened to her if she was caught in a storm

By Joseph Brinker

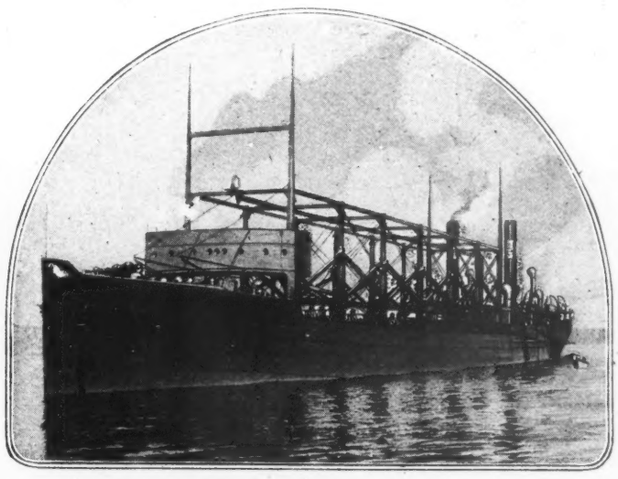
UNLESS the mystery of the United States collier *Cyclops* is solved at the peace table by a forced accounting of shipping losses on the part of the Germans, or unless some survivor unexpectedly turns up at this late date, the loss of the vessel, which has puzzled maritime experts the world over, is likely to go down as one of the most unusual in the annals of ocean shipping. It will be remembered that the vessel, one of the most modern of coal-carriers in the United States Navy, left Rio de Janeiro, Brazil, early in January, 1918, with a cargo of valuable manganese ore for Europe, and has not been heard from to this day.

The Navy Department has placed the *Cyclops* on the missing list as one of those that have passed to the Port of Missing Ships, never to return. The strangest part of the mystery is that, while the vessel was equipped with a most powerful wireless outfit, not a word was ever picked up from her.

There have been rumors that she was captured by a German submarine, and others that she was delivered over to some German vessel through the treachery of a German agent on board or blown up by a bomb placed in her cargo while it was being loaded.

If her loss can be laid to none of these causes, she must have gone down with all hands on board by some accident due to the elements of wind or water. There is a possibility that the *Cyclops* ran into a severe storm and foundered.

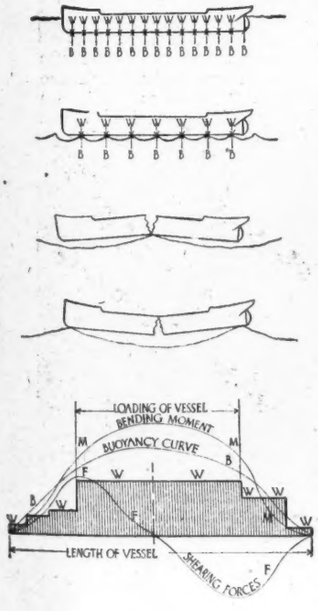
Provided her hull did not spring a leak and admit water faster than the pumps could get rid of it, she might have sunk in either one of two ways—by breaking apart amidships, or by capsizing due to a sudden shifting of her cargo.



The U. S. collier *Cyclops*, a giant of her kind, sailed for the Port of Missing Ships over a year ago. From the day she left Brazil, bound for Europe with a cargo of manganese ore, nothing has been heard of her, although she carried a powerful wireless equipment. No report has come of her sinking or capture. How is it possible for a ship to disappear, leaving no trace behind her?

If she broke apart amidships, the manner of her going is best illustrated by the accompanying sketches. These can best be understood by remembering that a ship floating in still water is held in equilibrium by two sets of forces, the weight of the vessel acting downward and the buoyancy of the water acting upward against the hull.

If she broke apart, it was either when she was balanced midway on the crest of a huge wave or supported only at her ends on a wave of her own length. In the first instance, she would be in the same position as a stick held across the back of a chair and broken by a person pressing downward at each end. If she broke apart when supported between the crests of a wave of her own length, it would correspond to a stick placed between two tables and broken by a weight placed at the middle. If she sank by capsizing, she simply was forced over on her side so far that she became topheavy and turned upside down.

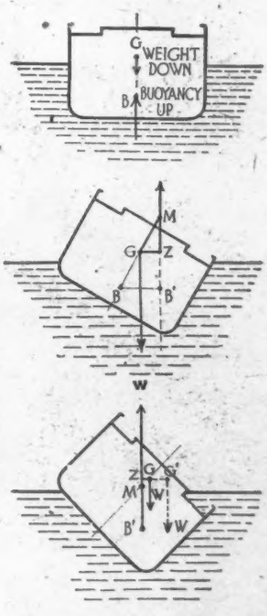


How Ships Break in Two

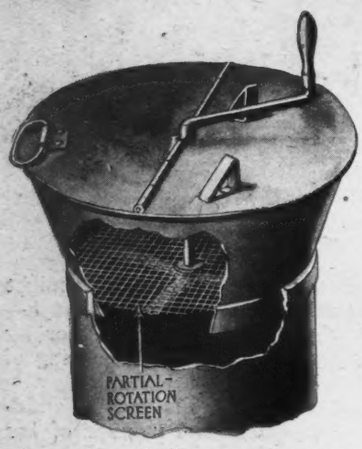
The two upper sketches show, first, how the weight (W) of the vessel in still water acting downward is balanced by her buoyancy (B) acting upward; and, second, an exaggerated view of the ship supported on the crests of six waves with the weight acting downward at those points to provide equilibrium. The next two sketches show, first, what may happen when the steel of a ship's hull is not sufficiently strong to stand the strain when the vessel is supported on the crest by a wave, and unsupported at either end; and, second, what happens sometimes when the ship is supported by the water at either end, but not in the middle, a wave having "run out from under her." It is quite possible that this was the fate of the *Cyclops*, owing to her heavy loading amidships. The bottom sketch is of typical assumed curves of the *Cyclops*, suggesting a way in which the heavy loading amidships might have caused her to break in two

How Ships Capsize

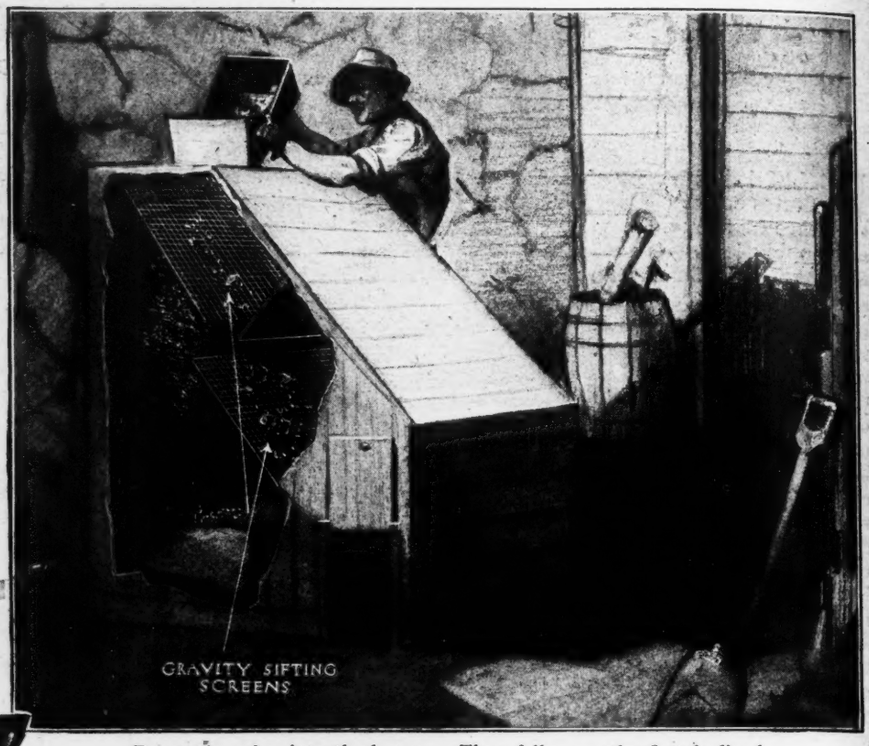
The upper picture shows transverse buoyancy with the weight of the vessel acting down through the center of gravity (G) and the buoyancy (B) acting upward through the same center. In the second picture the vessel is shown rolling. The center of buoyancy moves to B^1, and a vertical drawn through B^1 intersects the center line of the vessel prolonged at the point M. The distance GM is called metacentric height. The weight acting down through G and the buoyancy up through B^1 forms what engineers call a turning moment, WxGZ, tending to right the vessel. But when, as illustrated in the lowest figure, the vessel has turned on its side, so that the point M is below the point G, the weight W acts downward on the side most immersed, while the buoyancy acts upward through B, forming a force that will turn the vessel completely over. This is what may have happened to the collier *Cyclops* if her cargo shifted



How Inventive Ingenuity Has Played

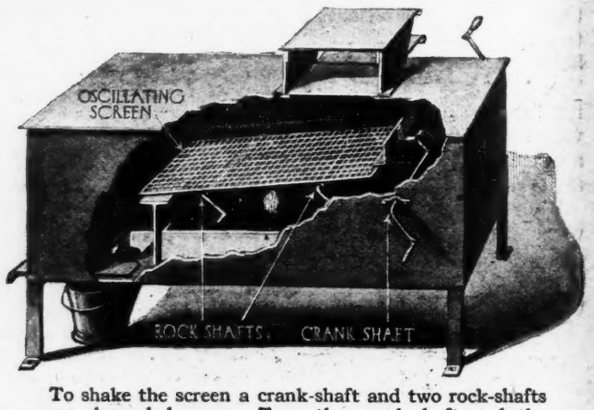


You put the ash-sifter upon your can; then you move the handle back and forth and vibrate the screen. No dust is scattered, because everything is inclosed

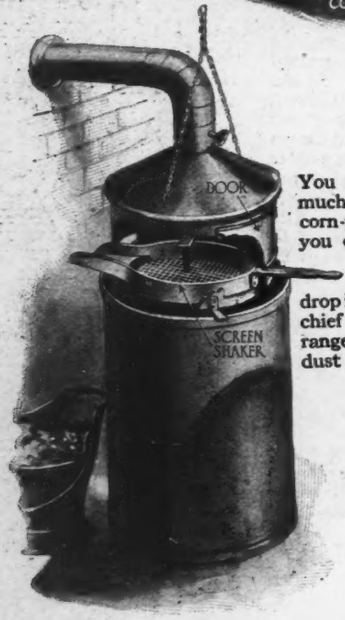


Dump the ashes into the hopper. They fall upon the first inclined screen. The heavy unsifted particles pass to the next screen. What coal is left is taken out by way of the door which is shown open

You don't have to shake anything in the apparatus shown at the left. The ashes trickle down on the cone - shaped screen, and this in turn spreads them



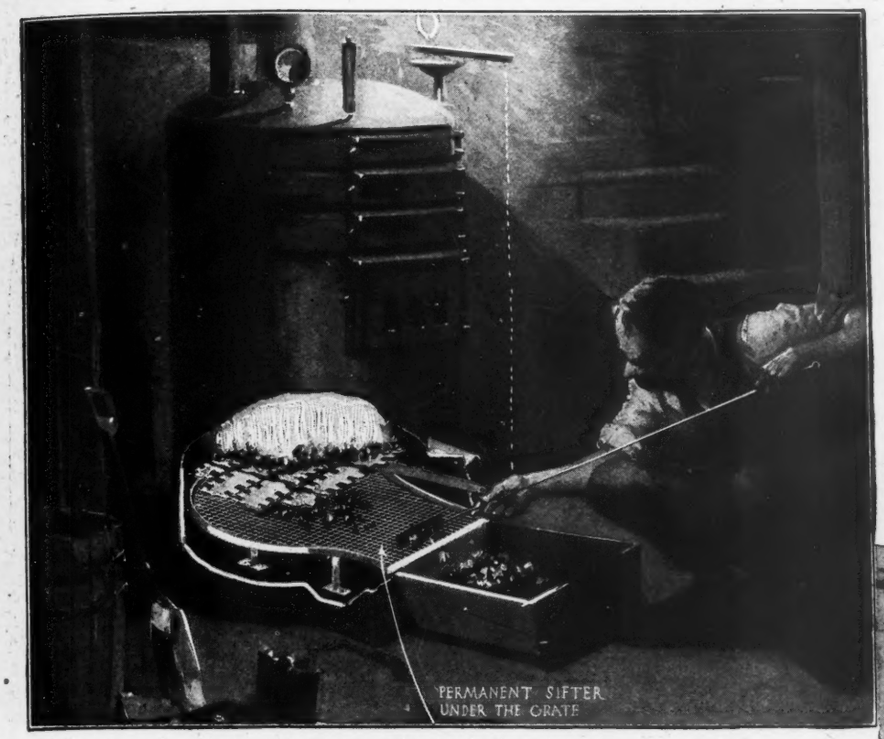
To shake the screen a crank-shaft and two rock-shafts are depended upon. Turn the crank-shaft and the screen moves back and forth. The ashes fall into a receptacle and pass out through a gate into a can



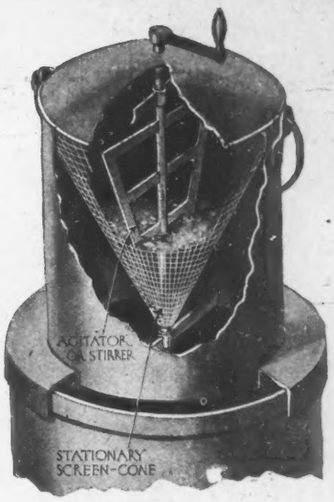
You shake the screen much as if it were a corn-popper, and then you open a door and tilt the screen so that the ashes drop into the can. The chief merit of the arrangement is that the dust is not scattered

Here we have the rocking-chair principle. Johnnie simply rocks the apparatus back and forth, the ashes drop down into a receptacle at the bottom, and the unburned coal can be withdrawn by opening a gate

Fairy Godmother to Modern Cinderellas



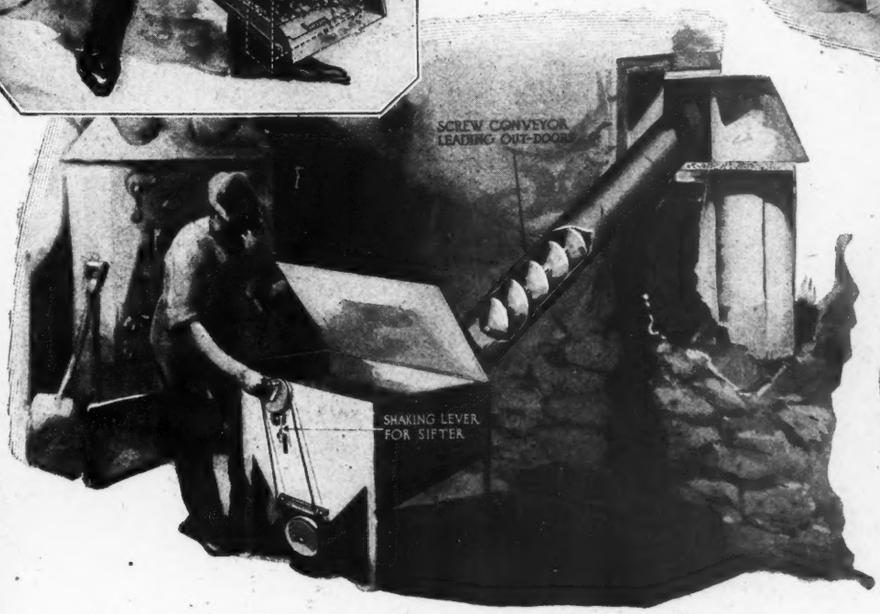
To clean the ash-pit, slide in two metal standards and two cross-bars to form a platform for the wire mesh. Then slide the two halves of the sifter into place. As you shake the furnace, everything is caught by the sifter. The ashes fall through to the floor; the fuel is left on the sifter to be used over again



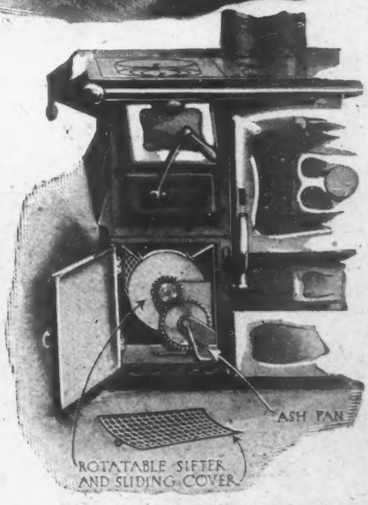
Another dustless ash-sifter. Here we have a stirrer used inside of a stationary screen. Turn the crank-handle at the top and the stirrer forces the ashes through the screen. The whole apparatus is placed on an ordinary ash-can

This is a wire screen shovel. The ashes are scraped up by means of a combined gate and scraper. During the shaking process the scraper becomes a gate, which opens and discharges the coal

Connected with the rotary screen is a fan which blows the ashes into the furnace so that they pass out by way of the natural draft

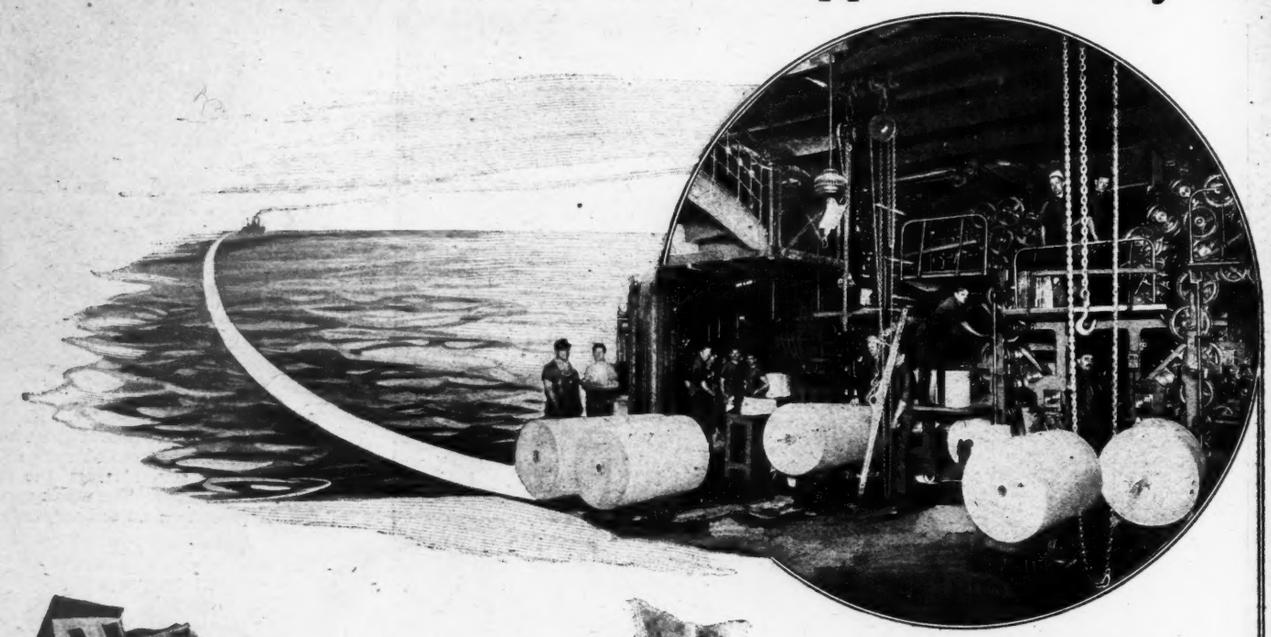


This saves the trouble of carrying the ashes out of the cellar. A screw conveyor leads up from the ash-sifter. Turn the crank, and you not only sift the ashes, but you convey them out of the cellar at the same time



This ash-sifter, built into the stove, shakes the grate. The ashes drop down into a rotary screen, which is rotated in such a way as to shake out the ashes

Paper — Made, Used, and Scrapped in a Day



Here is a ship laying a cable consisting of a long band of paper one foot eleven inches wide, of which newpapers pages are made. The ship is traveling 11,000 miles a day to keep pace with the printing-presses as they turn out newspapers for one day in New York city alone. When the twenty-four hours are done, the ship will have made two trips from New York to Liverpool, and will be well on the way home for the second time! Such is the ephemeral nature of a newspaper that twenty-four hours after it has been issued the greater part of it has become a "scrap of paper"

As soon as a letter arrives, the envelope becomes waste paper. All the mail delivered in a day will fill countless waste-paper baskets like these with envelopes

A large piece of paper, four miles square (the area of the daily newspapers of New York City), might come in handy for wrapping up a parcel. What could we put in it? This picture shows some of the things we could wrap up in the bundle, whose side is about 3,400 feet long. But the parcel is not nearly full, as you see

Finding Your Way in the March Skies

Some constellations are visible at all times of the year, but others come and go with the changing seasons

By Ernest A. Hodgson, *of the Dominion Astronomical Observatory*

THE coming of the spring flowers seems to be a signal for the gradual withdrawal of the brighter star fields from the evening skies. March is the last month in which Orion may be seen, Gemini is fast disappearing, and in their stead we have to be content with the fainter constellations of summer-time.

There are some constellations, however, which we have always in view—those of the northern heavens. If the Big Dipper is not concealed by clouds, it will enable the observer to locate not only the pole-star, but also Castor and Pollux in Gemini; Regulus in Leo; Capella in Auriga; Arcturus in Boötes; and the constellation of Cassiopeia. If now we trace a line from Capella through the pole-star, and continue the arc a little farther than from Capella to Polaris, we come to the clear white star Vega, in the constellation Leo. This star is not shown on the circular map, but can be seen rising in the north-eastern sky about ten o'clock at night toward the end of the month. It would be well to become used to its appearance in different positions, for it is one of the interesting stars of the summer sky and helps to guide one among the fainter constellations.

Having located Gemini by means of Ursa Major, it is well to remember that the twins, as they face away from the Great Bear, look toward their guardian, Orion. Having located the latter, the line through his belt, carried northward, indicates the position of, first, Aldebaran, and then the Pleiades. Carried southward, it brings us to the brightest star visible in northern latitudes—Sirius, the Dog-Star. The bright star next in line, if we trace from Polaris through Gemini, is Procyon of Canis Minor, the Little Dog.

With the coming of summer the Milky Way also disappears from view in the evening. It would almost seem that the beauties of the earth in summer, and of the sky in winter, were mutually compensating us each for the loss of the other. Under the telescope the Milky Way is resolved into countless numbers of faint stars.

If we call photography to our aid, and allow the star images to be focused by the telescope for long hours upon a photographic plate, we find the number of stars recorded very much greater.

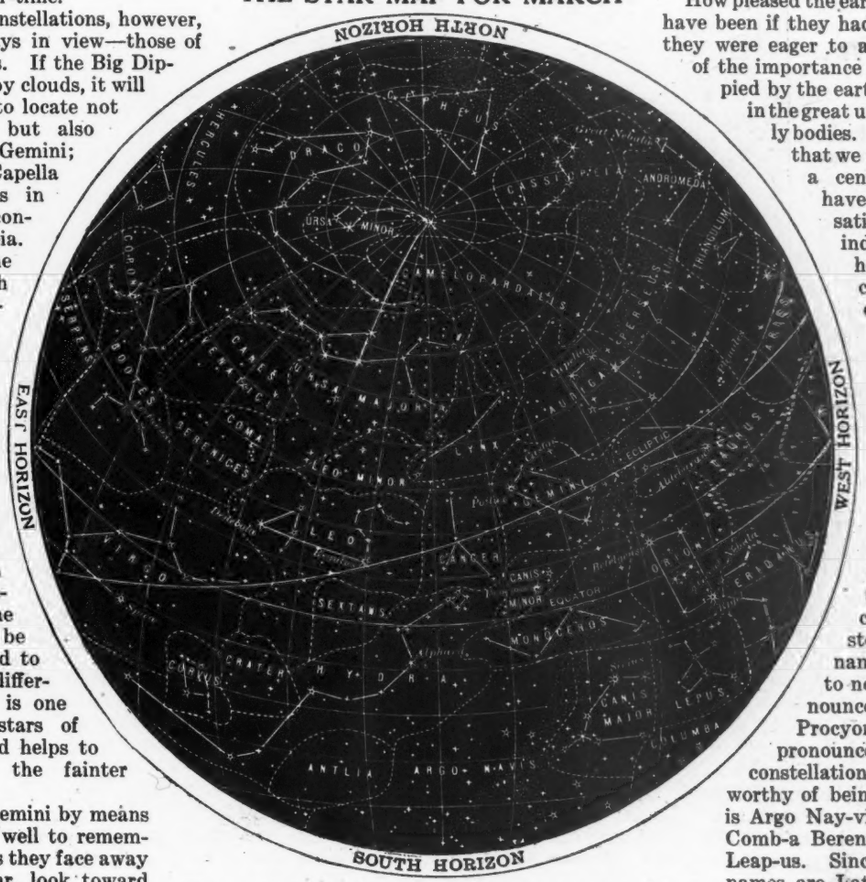
Each of these stars is a sun, shining with its own light, just as our sun does. The reason the stars appear so much greater in number in the Milky Way is because of the arrangement of the universe. Since we see the Milky Way almost equally dense, throughout its entire circuit, we must conclude that we are not far from the center of the universe in the direction of its greatest spread.

How pleased the early astronomers would have been if they had thought of this, for they were eager to accept any indication of the importance of the position occupied by the earth and its inhabitants in the great universe of the heavenly bodies. To them, the thought that we and our Sun occupied a central position would have brought immense satisfaction. They held, indeed, that it was heretical to deny the central position to our earth, since the wording of the story of creation seemed to indicate that the Sun and Moon and stars were created to move about the earth in their daily course through the sky.

To the beginner it is a matter of some importance to learn the correct pronunciation of the constellation and star names. It would be well to note that Rigel is pronounced Ree-gel, and that Procyon in Canis Minor is pronounced Pro-see-on. Of the constellations the following are worthy of being noted: Argo Navis is Argo Nay-vis; Coma Berenices is Comb-a Beren-ice-ces; and Lepus is Leap-us. Since many of the star names are Latin, it is a safe rule to follow the Latin methods of pronunciation when in doubt as to star names.

Coma Berenices is just coming into view. It is one of the most beautiful of all the constellations, being composed of strands and groups of great numbers of faint stars. The beauty is greatly increased if an opera glass is available. Bernice was a queen to one of the Ptolemies, King of Egypt. Her husband was very successful in one of his wars, and as a thank-offering Bernice sacrificed her beautiful hair to the gods. It was laid away in the shrine, but shortly afterward was discovered to be missing. The priests assured the queen that Jove had taken her gift and given it a special place of honor. As proof of this they pointed out her beautiful hair shining, in honor, in the skies above. And there it remains, as beautiful as it was then.

THE STAR MAP FOR MARCH



This map represents the appearance of the sky at the times listed below. It is specifically arranged for the latitude of New York, 40°N., but is practicable for ten degrees on either side of this latitude.

February	2, midnight		March	29,	8:30 P. M.
"	9, 11:30	P. M.	April	7,	8 "
"	17, 11	"	"	15,	7:30 "
"	25, 10:30	"	"	23,	7 "
March	5, 10	"	May	1,	6:30 "
"	13, 9:30	"	"	9,	6 "
"	21, 9	"			

The magnitudes are indicated on the map by stars of various kinds as follows: 0, open center; 1, eight points; 2, six points; 3, five points; 4, four points; 5 is indicated by a single point. Eastern Standard Time.

The POPULAR SCIENCE MONTHLY *is publishing every month an article like this by Mr. Hodgson. If you feel that these articles can be made more helpful, write to the editor. And if there are questions that you would like to ask about stars, send them along.*

How to Find the March Planets

THE planet map this month has been put into a different form. It will be found much simpler to use. The positions of the planets, the Sun, and the Moon are plotted directly on the map itself, and their positions are indicated on the open scale of the chart lines outside the map. A few minutes spent in cutting out the little disk of cardboard will enable the reader to answer for himself all questions with regard to the appearance of the sky at any time during the month, as well as the time of rising and setting of any celestial body.

Specially Interesting This Month

The movements of the planets and the Sun are this month especially interesting. The Sun is in the constellation of Pisces, the "fishes," with the exception of the few days at the first of the month, when it is in the constellation Aquarius, the "water-carrier."

On March 21 the Sun crosses the celestial equator. Since that line in the sky passes through the exact east-and-west points for persons anywhere in the world, the Sun on that date will rise exactly in the east and will set exactly in the west. It will be in the sky precisely twelve hours, giving equal day and night over the whole earth.

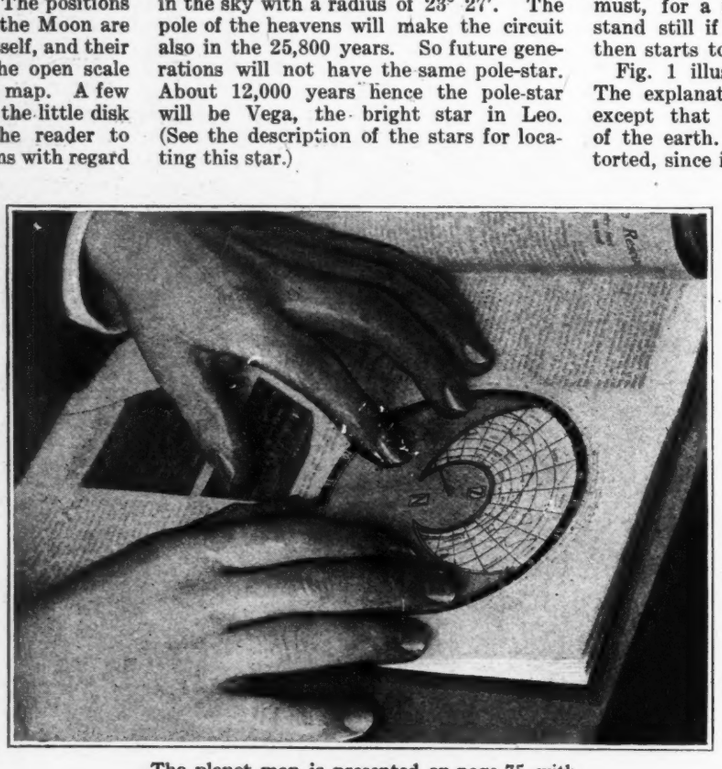
This point in the sky where the ecliptic crosses the equator as the Sun comes above the latter is called the Vernal Equinox, *i.e.*, the position in the *spring* which gives *equal day and night*. It is often referred to as the "First of Aries." It is the first, or the beginning, from which the Right Ascension hours (see the Roman numerals at edge of the planet map) are counted.

In measuring longitude on the earth, a starting-point had to be chosen: Greenwich was the choice. In measuring Right Ascension in the sky, a starting-point had to be chosen: the Vernal Equinox was the choice. When first chosen this point lay in the constellation Aries. Hence the term "First of Aries."

Twelve Thousand Years from Now

After the lapse of centuries this point was found to have been moving. Observations have determined that it is moving westward in the sky at a rate that will cause it to complete the circuit of the heavens in 25,800 years. This movement is known as the "Precession of the Equinoxes."

As the equinoxes move, so also does the celestial pole, the latter tracing out a circle in the sky with a radius of 23° 27′. The pole of the heavens will make the circuit also in the 25,800 years. So future generations will not have the same pole-star. About 12,000 years hence the pole-star will be Vega, the bright star in Leo. (See the description of the stars for locating this star.)

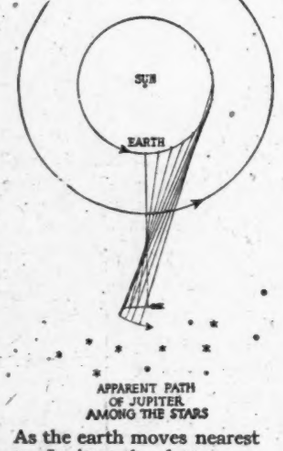


The planet map is presented on page 75, with directions about using it as illustrated here

A very interesting theory in regard to the pyramids of Egypt is that certain tunnels built into them were made to point exactly to that part of the heavens which was the pole of the sky at that time. Assuming that the tubes were so built, and knowing the rate of precession of the equinoxes, a measure is obtained for the antiquity of the great stone piles of Egypt. Will they still be standing when, at the end of 25,800 years, the pole has again come round to the place it occupied when they were built?

Mercury is to the east of the Sun throughout the month.

It is farthest east about March 28. It is then "stationary." That is, for a day or two it apparently stands still among the stars. Thereafter it appears to move west in the sky instead of east.



As the earth moves nearest to Jupiter the latter appears to move backward

Retrogression of the Planets

It will be remembered that in January and February Jupiter, Saturn, and Neptune were apparently moving westward. It will be noted this month that Jupiter is moving eastward again. It was "stationary" about the first of the month of March—March 2, to be exact. This "retrograding" of the planets is an interesting phenomenon to watch. It is always preceded by the stationary point, as of course the planet must, for a moment at least, appear to stand still if it is moving eastward and then starts to move westward.

Fig. 1 illustrates the case of Jupiter. The explanation for Mercury is similar, except that its orbit lies within that of the earth. The diagram is much distorted, since it is, of course, impossible on the same scale to represent the orbits of the earth and Jupiter and the positions of the distant stars. The positions of the earth and Jupiter for the same date are joined by a line showing the direction along which an observer on the earth would look to see Jupiter.

How Jupiter Progresses

As the earth moves about in its orbit nearest to Jupiter it moves so fast that the latter is left behind and appears to move backward among the stars. As the earth nears the point where it passes to the side of its orbit opposite to Jupiter, it, for a time, travels along the line of sight as it were, and Jupiter is "stationary." Then, reaching the far side of its orbit, it tends to make the apparent motion of Jupiter faster and faster in the true eastward direction again.

We see a somewhat similar phenomenon when we watch an automobile running beside a street-car on which we are riding. The automobile seems sometimes to move forward and sometimes backward, depending on the relative motion of the two moving bodies.

Ideas of the Early Astronomers

Early astronomers were hard put to it to explain the retrograde movements of the planets. They insisted that the earth was stationary and the center of the celestial bodies. To explain the retrograding, they supposed that the planets moved in circles about points on a great crystal sphere, which also itself rotated about among the stars, the earth being at the center of all. As soon as it was admitted that the earth moved, and that the Sun was at the center, the cumbersome "cycles" and "epicycles" of the astronomers were discarded.

Mercury, Venus, and Mars are all to the east of the Sun throughout the month, and so set after it; they are evening stars. It must be remembered that they are not *stars*, as they do not shine with their own light. (Note the extremely variable rate of Mercury during the month.) All are near the Sun.

The two former are always near the Sun, as pointed out in a diagram last month.

Saturn continues to retrograde a little to the west of Regulus. Uranus and Neptune—the telescopic planets—are but

slightly displaced from their positions of last month. The latter is still retrograding.

During the month the Moon succeeds in avoiding the Sun at new Moon and the earth's "shadow" at full Moon. It thus fails to eclipse the Sun in the first case or become eclipsed in the second. New Moon may be readily picked out on the chart lines. It is on the date that corresponds in position on the chart lines of the Sun and Moon. Clearly, this is between the 2d and the 3d. The exact time is 6h. 11m. A.M., E.S.T. on March 2. Full Moon —the time of coincidence of the Moon and the earth's "shadow"—occurs at 10h. 41m. A.M., E.S.T. on March 16, first quarter and last quarter respectively at 10h. 14m. P.M., E.S.T. on the 8th, and 3h. 34m. P.M., E.S.T. on March 24. There is another new Moon on March 31 at 4h. 5m. P.M., E.S.T.

Conjunctions of Planets and Moon

The relative motions of the planets and the Moon cause the following "conjunctions" or near positions of the planets and the Moon: Venus on March 3; Jupiter on the 9th; and Saturn on the 13th. Venus will appear along with a thin crescent Moon in the evening sky on the date given. At conjunction with Jupiter it will be about first quarter, and, if the night is clear, will make a strikingly beautiful showing above Orion. It will be coming nearer full at the conjunction with Saturn, and will make a fine group, with the bright star Regulus a little to the east.

How to Use the Planet Map

The planet map shows a belt completely about the sky, 30° wide on each side of the celestial equator.

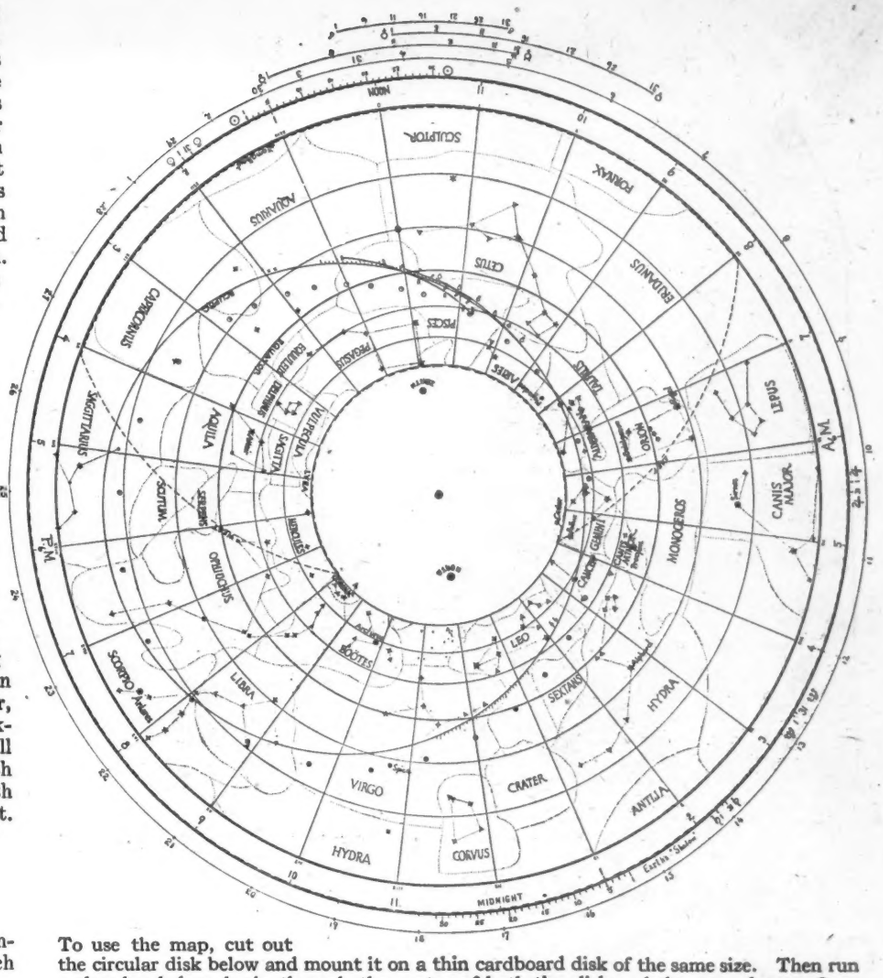
To use the map, cut out the circular disk on this page and mount on a thin cardboard disk of the same size. Then run a glass-headed push-pin through the center of both the disk and the map. It is now ready for use. Once made, it will serve from month to month.

To see the section of sky visible at any time on any date, turn the disk until the required hour (on the disk) is opposite the required date (on the chart line of the Sun).

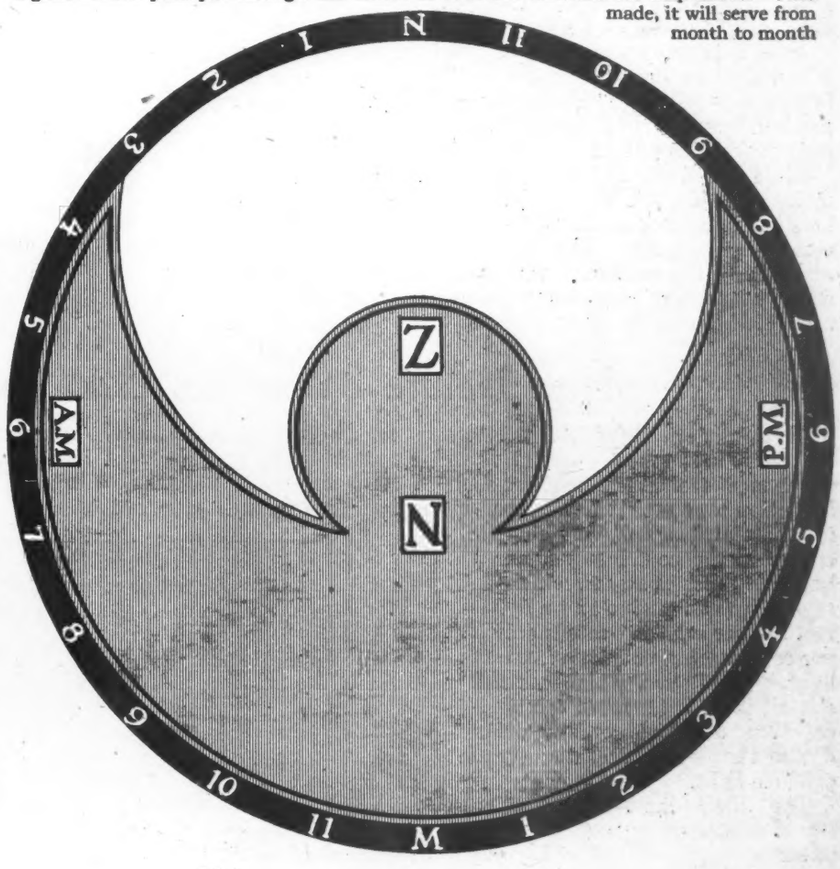
To see when a planet (or the Sun or Moon or any star) rises or sets or reaches the meridian on any given date, turn the disk until the position of the body, *on the map itself for the required date*, is on the eastern or western horizons, or in the center of the cut-out section as the case may be. The hour is to be read off on the edge of the disk, *opposite the required date on the chart line of the Sun.*

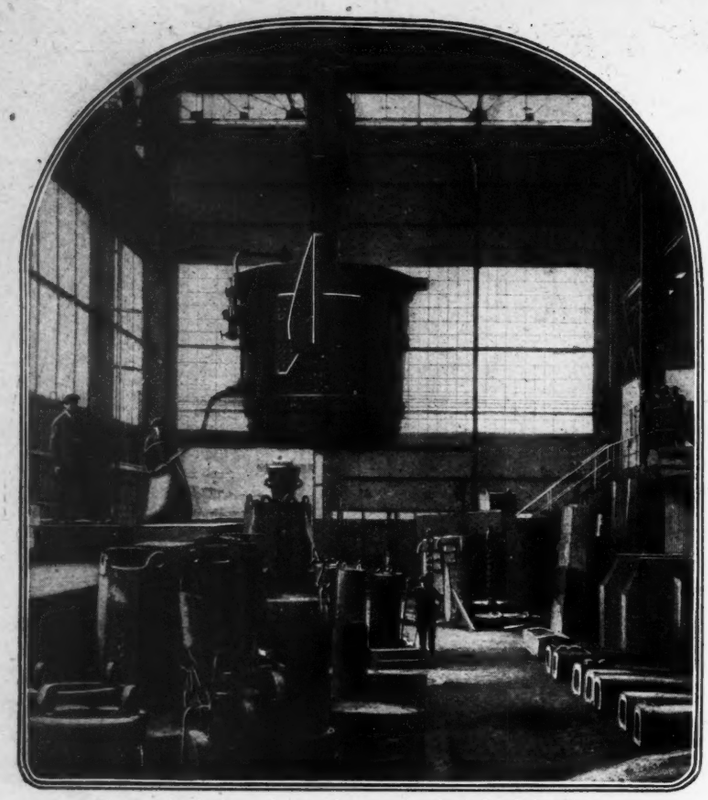
Mercury lies so close to the Sun as to be scarcely ever seen. Venus, Mars, Jupiter, and Saturn can be seen as bright stars when properly placed with respect to the Sun. Uranus and Neptune are too faint to be seen with the naked eye, but are visible in a small telescope. The Moon positions are indicated by circles, the inked-in portion showing the illuminated part. The planets are indicated by the following signs:

MERCURY	☿	SATURN	♄
VENUS	♀	URANUS	♅
MARS	♂	NEPTUNE	♆
JUPITER	♃	SUN ☉ AND MOON ☾	



To use the map, cut out the circular disk below and mount it on a thin cardboard disk of the same size. Then run a glass-headed push-pin through the center of both the disk and the map above. Once made, it will serve from month to month





By manipulating a lever, the man in the left of the picture operates the ladle, which contains fifty tons of steel

Handling Hot Liquid Steel

ONE of the most difficult problems in large steel-mills is the handling of the intensely hot liquid steel, after it is made in the steel-furnaces. Contact with it means instant death, and there is also danger of fire from the metal.

After it is ready to be tapped from the furnace in which it is melted and purified, the metal is allowed to flow into a large pot or ladle. The illustration shows one of these suspended from a traveling electric crane. The ladle holds about fifty tons of liquid steel.

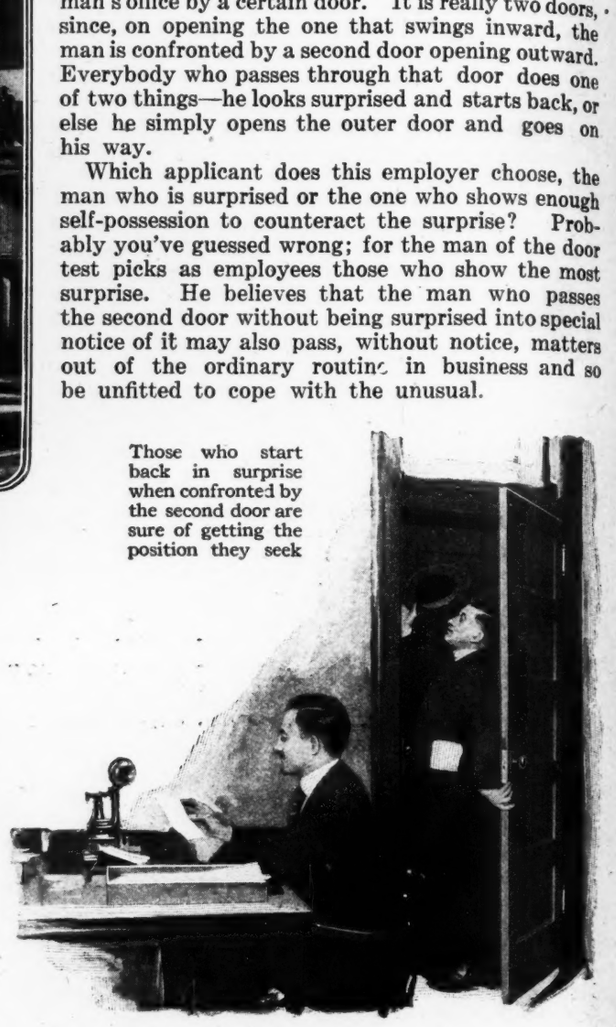
After it has reached the ladle, it must be transferred to molds. To do this the hot metal is allowed to flow from a hole in the bottom of the ladle, and this hole is opened and closed by a lever. This lever is a special mechanism attached to the outside of the ladle, which raises and lowers a long stopper, or plug, inside the ladle and attached to the arms of the lever reaching over the top of the ladle's side.

His Magic Door to Success

ELABORATE psychological and physiological tests have been worked out for the purpose of determining the special fitness of applicants for employment, but many employers have evolved simple tests of their own.

A strange method is used by an employer who is said to have interviewed more men and women seeking positions of reponsibility than any other man in the world. Applicants are directed to leave this man's office by a certain door. It is really two doors, since, on opening the one that swings inward, the man is confronted by a second door opening outward. Everybody who passes through that door does one of two things—he looks surprised and starts back, or else he simply opens the outer door and goes on his way.

Which applicant does this employer choose, the man who is surprised or the one who shows enough self-possession to counteract the surprise? Probably you've guessed wrong; for the man of the door test picks as employees those who show the most surprise. He believes that the man who passes the second door without being surprised into special notice of it may also pass, without notice, matters out of the ordinary routine in business and so be unfitted to cope with the unusual.

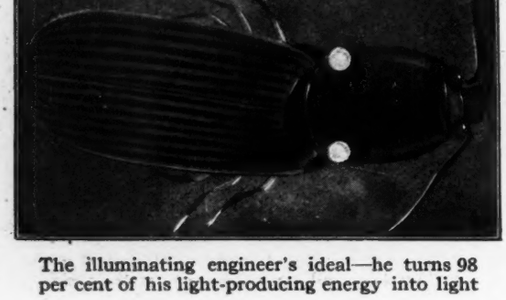


Those who start back in surprise when confronted by the second door are sure of getting the position they seek

How Nature Solves the Cold Light Problem

THE modern incandescent electric lamp is the most wasteful as well as the most economical light-producing invention that man has invented. It is wasteful because, of all the energy in the coal burnt under a boiler to produce steam, which in turn drives an engine and a dynamo, 98 per cent is wasted; only 2 per cent reaches us in the form of light. And yet, this wasteful electric lamp is far more economical than a candle or any other device that burns fuel directly to produce light.

The ideal light-producer, so far as efficiency is concerned, is nature's firefly. Fully 98 per cent of the energy that the creature puts forth to produce light manifests itself in visible radiation. What is more, the firefly's light is cold.



The illuminating engineer's ideal—he turns 98 per cent of his light-producing energy into light

The best of nature's light-producers is to be found along the coast of Cuba. It is a giant beetle with two brilliant phosphorescent spots that make it look as if it had headlights.

So bright is the light which these spots give out that the natives actually use the beetles instead of lamps. A hundred beetles in a glass jar give a soft, cold glow by which it is possible even to read a newspaper.

Why didn't nature go a little further? If there were a thousand-candlepower beetle, we would capture him and hang him over our front door.

Don't Hide Your Adam's Apple

Although not generally known, it is a sign of brains and courage

By John Walker Harrington

THAT fruit of the family tree, the Adam's apple, was much talked about not long ago because General Pershing referred to it as being a prominent feature of the neck of the American fighting man. He suggested that the collars of the soldiers' uniforms be kept high, and not loose or flowing like the English model, evidently taking it for granted that men would rather hide their Adam's apples under a bushel.

Go to Haeckel

Some of us have been unusually marked by the relic of Eden; but let us look our scoffers and critics squarely in the eye and tell them to go to Haeckel. That noted biologist and others of his class have traced the descent of man in a way which shows that we came from small beginnings, and kept getting wiser with the ages.

Scientists are inclined to accept the theory that man came by long descent from ill-formed, spineless things that came to life by chemical action, probably in some tepid mineral spring, and found their way to the ocean. Then came the fish, which, as soon as they got backbones, began to develop something like Adam's apples. A man without an Adam's apple would be a poor fish. From the primitive forms of the ancient seas are believed to have come the mammals, from which sprang the human race. It is a long story.

Lincoln helped to prove that an Adam's apple indicates brains

If you should happen to be in the American Museum of Natural History some Sunday, take a look at the restorations of the prehistoric forebears of our race by McGregor, and note how the Adam's apple is almost absent in the earlier forms and becomes larger as the scale of intelligence ascends. The ancient Greeks depicted their strong heroes and their highest types of manly beauty with the wedge-like mark in the neck.

This ancient European, whose intelligence was not great, has a very small apple

Photograph from American Museum of Natural History

Great Men Who Had Them

Modern artists, sculptors, and photographers are inclined to flatter their sitters by leaving out the Adam's apple; and as for many centuries the high stock was in vogue, its presence was much obscured. It is marked, however, in such men as Franklin and Voltaire.

The Adam's apple of Lincoln was so big that even as faithful photographers as Hesler and Brady toned it down somewhat on the negatives. The life-mask of Volk and the conscientious studies of George Grey Barnard all show the long, lean neck and the wide-angled wedge of the thyroid cartilage.

Take, then, the Adam's apple as a a badge of brains and courage.

Primitive China Still Hauls Junks by Man Power

CHINA, land of glowing lanterns and dainty silk-clad maids, has, alas, its dark corners, too. Her simple, primitive mode of living is responsible for conditions that should make "prevention of cruelty" societies drop our children and fly to China.

On large rivers like the Yang-tze-Kiang, sailboats, called junks, are still used as cargo-carriers. When the wind is favorable there is little work to be done by the dirty, half naked crew, who continually cry to the gods:

"Plenty wind, no work; no wind, plenty work!"

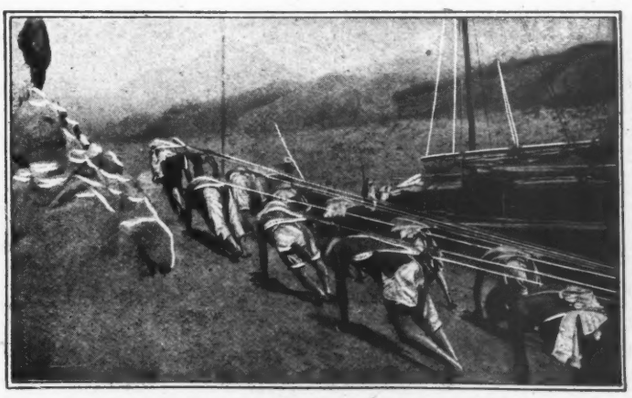
When the boat reaches the Tsin-Tan rapids, the gods fail them. No propitious wind alone will carry the frail boats over.

Men, women, and children are put in harness on the shore and attached to the junk, which they haul by sheer brute strength.

These trackers, as they are called, lean forward, touching the ground with one hand, and holding on to the harness with the other. They dig their toes in the soft dirt and pull with all their might, working their way along inch by inch, and emitting long drawn-out wails.

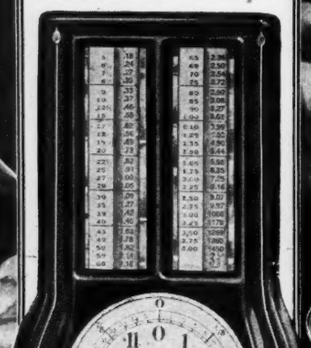
Meanwhile a tracking master runs up and down, shouting and beating the trackers into further effort. So strong are the rapids that sometimes three hundred trackers are used.

The illustration shows the leaders of a crew fighting their way along the shore. The junk they are hauling is a long distance behind them.

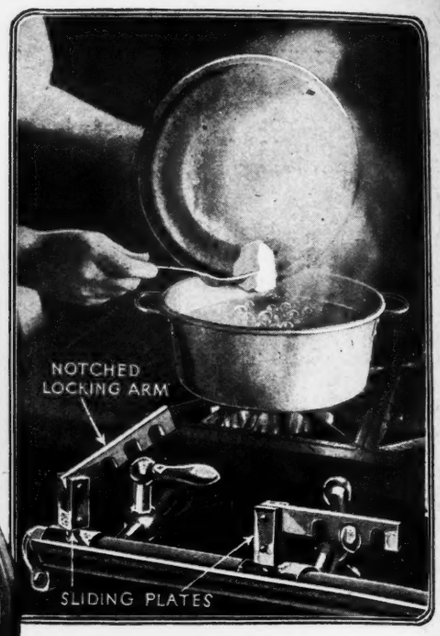


Only the first few of a long line of coolies who are hauling a junk up a river against the rapids

In up-to-date shops the sales-girl measures the goods not by guess-work but by a little machine



The hour-hand marks the yards and the minute-hand the inches



If the gas-jet is locked, the gas can't be accidentally turned on

No More "Long Yards"

NOWADAYS, when everything costs so much, no merchant can afford to have his profits eaten into by long yards. Neither does the customer care to receive thirty-five inches of cloth for a yard. But just as long as people measure over tacks, the chances are that yards will not be yards.

A little device has made its appearance which measures cloth or ribbon accurately, and computes the price to be paid for the article, whether it is an eighth of a yard or ten yards and three quarters. This little machine has a dial similar to a watch dial. The long hand registers inches and the short hand yards. The yards are shown in large type, the inches in small type. On the rim of the dial the fractions of yards are shown in eighths. Inch divisions are indicated by small red figures.

In order to operate it, the piece of goods to be measured is slipped through a groove, and as it is drawn through the machine the dial indicates the amount of material which is passing through the device. The calculation is made in a very simple manner. Prices per yard are in red and the computations in black. When the measurement has been made the amount of the sale is found on a cylinder directly opposite the price.

Three little buttons govern the apparatus: one for starting the measurement; one for notching the edge of the fabric; and one for resetting the hands and chart to zero. The computation chart moves automatically as the goods passes through the machine.

We Send a Man to Europe

REBUILDING war-wrecked Europe is a big job. Man-power alone can't do it. The best engineering skill, inventive genius, and machines—machines and still more machines—must be the answer.

There will be thrilling stories to tell of engineering and inventive triumphs, and the camera will be the best reporter. POPULAR SCIENCE MONTHLY is already in the field. George F. Paul, who has set up his camera in every corner of Europe and Mexico, is on the sea as this is being written, bound for France, to begin making pictures for us. His camera will catch the most dramatic moments in the work of reconstructing Europe.

Lock Your Gas-Jet

SERIOUS accidents, involving the loss of human life, are often caused by the unintentional opening valves on gas-stoves. Of course, the safest way to prevent such accidents is to shut off the main valve of the supply-pipe, but that precaution is seldom taken.

An invention by John E. Cadigan, of New York, diminishes the danger incurred by leaving the main supply-pipe open. A strip of metal, properly curved and provided with flanges, is attached to the feed-pipe of the gas-stove by means of ring-shaped clamps which are bolted around the feed-pipe.

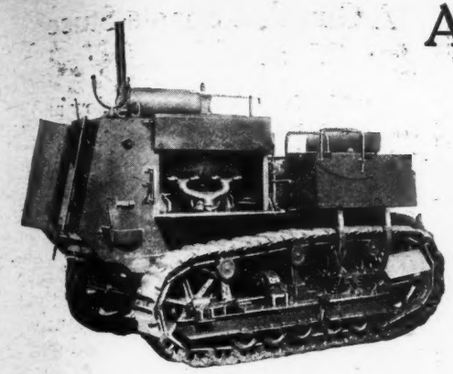
Short, curved metal plates fit between the flanges of the strip, so that they can be slid along forward or back in the direction of the strip.

The number of these plates corresponds with the number of service valves in the feed-pipe. Each plate bears two lugs, between which is pivoted a notched arm, which may be turned up in a vertical position or swung down to a horizontal position, so as to engage the handle of the corresponding feed-valve in one of the notches of the pivoted arm. Retaining springs hold the arms securely in position when they are swung down horizontally to lock the valve-keys.

Each arm has three notches which fit over the valve handles. By sliding the plates to which these notched arms are pivoted between the flanges holding them, the arms may be adjusted to lock the valves in any desired position.

A Cure for "Shell-Pox"

How the crater fields of France may be reclaimed by American machinery



How the caterpillar tractor looks with its fighting clothes on. This type was used to haul our artillery in France

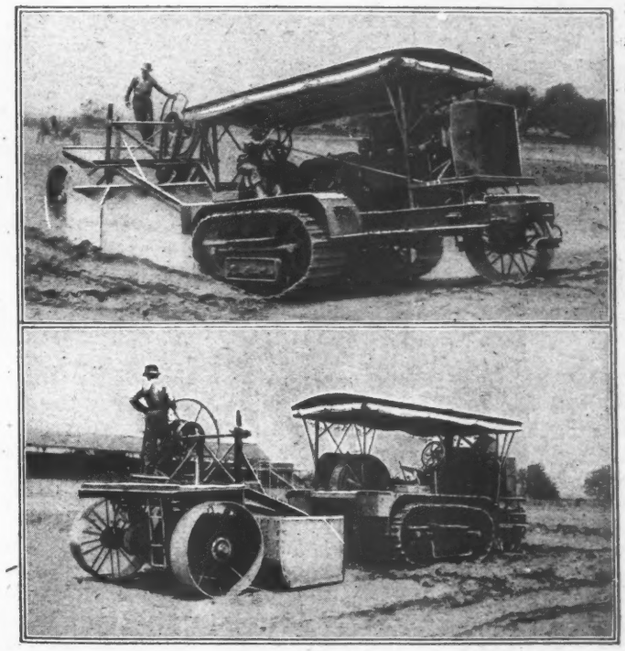
THE devastated farms of Europe may be smoothed out and put under cultivation again by the same power that helped destroy them. American ingenuity, which gave the Allied armies the "caterpillar" tractor to haul their great guns, has given Western farmers a big-scale land-leveler that may be the solution of the vast problem of agricultural reconstruction wherever heavy artillery has fought.

Thousands of American tractors that were used on the western front will probably never return to the United States and England, at least not until the battle-scarred soil has been put back in condition to support life.

California, in the person of Benjamin Holt, gave the world the combined harvester, which cuts, threshes, and sacks grain at one operation; the sage-brush plow and rake, which has cleared enormous areas of desert land, subject to irrigation; and a huge land-leveler, which has flattened out the surface inequalities of these areas and so fitted them for the easy distribution of water. It was a baffling California soil condition that inspired Holt also to produce the "caterpillar" tractor, which supplied the power for the other implements.

The land-leveler is remarkable for its size and ruggedness. A heavy scraper blade, capable of carrying the contents of two big dump-wagons, is mounted on a strong frame supported by two wide-tired wheels. The blade is raised and lowered by a rack and pinion. The pinion shaft may be operated either by a large hand wheel or a belt drive from the main axle.

The great guns which stood hub to hub at Chateau-Thierry and smashed the last German drive will, let us hope, have nothing more to do for generations. But the tractors diverted from American farms, like the Yanks themselves, are ready to lay aside war equipment and help to rebuild Europe.



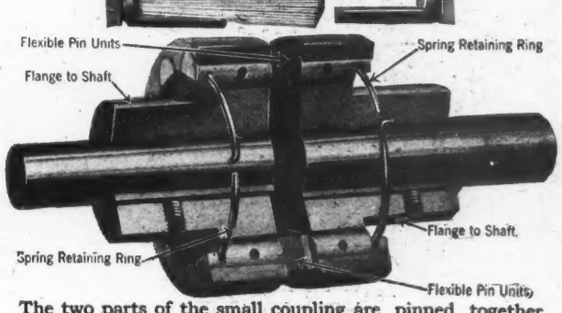
Hitched to a land-leveler, this tractor does the work of thirty-six horses and six men. It can go anywhere a tank can—and a tank can go anywhere

Here Is a Good Way to Join Wabbling Shafts

EVEN if the ends of shafting do wabble, they can be connected by any one of a dozen devices. One of the methods used with the shafting of dynamos and motors is here illustrated. A part of the coupling is keyed to the end of one shaft, and another part is similarly joined to the other shaft. Between these two parts the flexible portions of the couplings extend.

Small bundles of springs, with slotted holes in each end, join the ends of the two shafts and are held in place by pins. The slots provide for endwise slipping, which must occur if the two shafts are slightly out of angular alignment as they revolve.

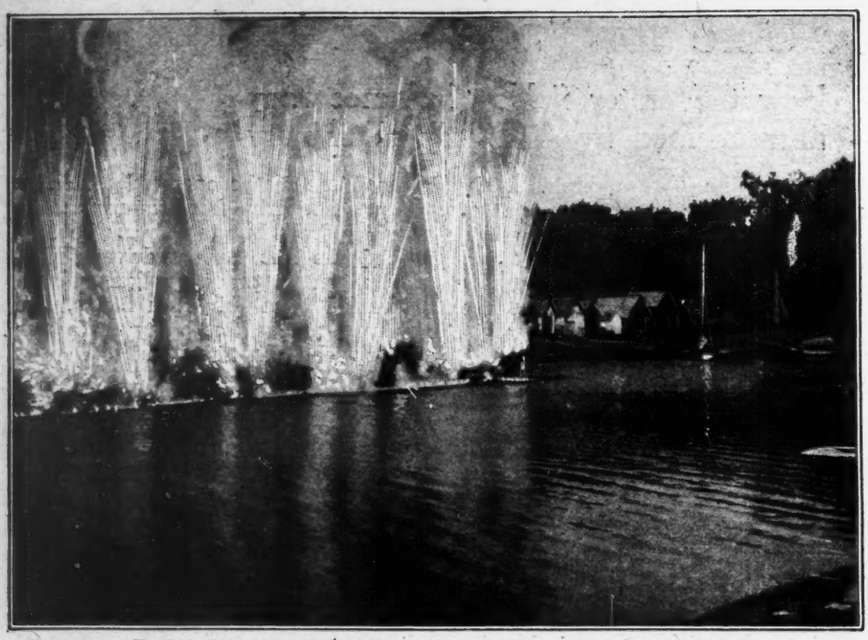
The small figure shows how the little bundles of flexible couplings or springs are made up. When the raised pin is lifted a little higher, the two parts may be forced together and the pin can then be driven into the slotted hole. The other end is pinned in a similar way.



The two parts of the small coupling are pinned together and arranged in the larger one to make the joint flexible

The larger figure shows how a number of these small bundles of springs are arranged about the ends of the shafting. They are held in place by suitable springs. The flexibility of the spring bundles, in connection with the slot movement referred to above, allows for any misalignment of the shafts.

The correct aligning of shafting has occupied the minds of engineers for a great many years, and any improvement in methods is always welcomed.



Taking thought and some dynamite cartridges, a motor-boat enthusiast found an easy way to cut a channel through a bothersome shoal

It Was Dynamite that Did It

THERE wasn't water enough over a shoal in the Mascoma river in New Hampshire to float small motor-boats, but there was too much to allow men to work there with shovels or with teams and scrapers. W. A. Saunders, who had used dynamite for stump-blasting, solved the problem.

He buried dynamite cartridges of 75 per cent strength a foot and a half in the gravel on the shoal, spacing the charges two feet apart, put a blasting cap on the middle charge, knowing that the other charges would be set off by concussion, and let her go.

There followed the wonderful water curtain display shown in the picture, and up with it went enough of the shoal to leave a channel two and a half feet deep and five feet wide—which was all the motor-boat owners needed to make them happy.

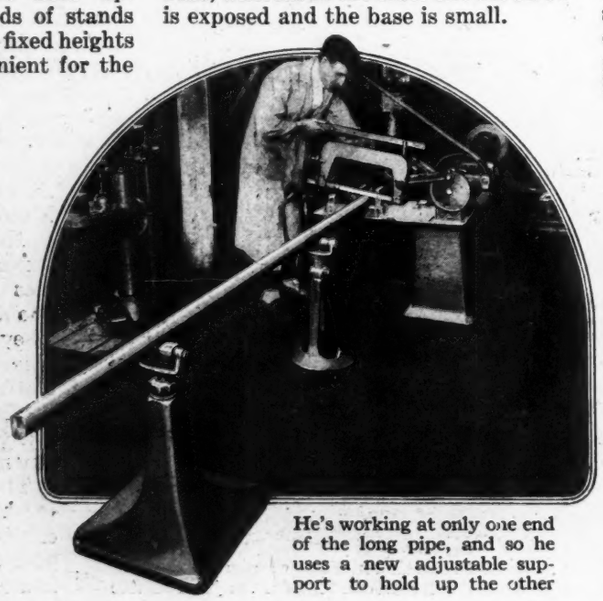
These Stock Supports Are Adjustable

WHEN one end of a long pipe is being worked on in a machine, the remainder should be held up. Several of the many kinds of stands for supporting stocks have fixed heights which may not be convenient for the work at hand.

The supports shown here are adjustable, and may be screwed up or down to suit the operator. That part of the support on which the stock actually rests is cylindrical in shape, and is grooved so that the pipe may rest securely.

A support like this may be used in connection with hacksaws, screw machines, band and circular saw machines, bolt-cutters, etc.

The two supports shown here are different in style but alike in principle. The nearer one is of newer design. The screw is completely hidden in a very substantial base, whereas in the older one the screw is exposed and the base is small.



He's working at only one end of the long pipe, and so he uses a new adjustable support to hold up the other

A Gun that Shoots Stucco at a House

STUCCOING by hand is slow and the results poor. For example, when a metal lath is plastered by hand three coats are necessary, and even then the mortar seldom reaches through to the back of the lath.

The result is that the metal deteriorates, causing loosening of the plaster so that repairs are constantly necessary. But the centrifugal gun hurls mortar at a lath with such force that it is sent through the lath to the very back.

Ey this method he covers 450 sq. ft. an hour

This so-called gun is really a small machine consisting of a ⅛-horse-power motor with four spider blades attached to it. When the motor is started, the blades revolve and hurl out the mortar. The bearings are protected from grit and cement by heavy felt gaskets. The gun is attached to springs fastened to a strap which fits around the operator's neck, leaving his hands free. The entire outfit weighs only thirty-two pounds. One man operates the gun, while a helper stands by to feed the mortar into the machine.

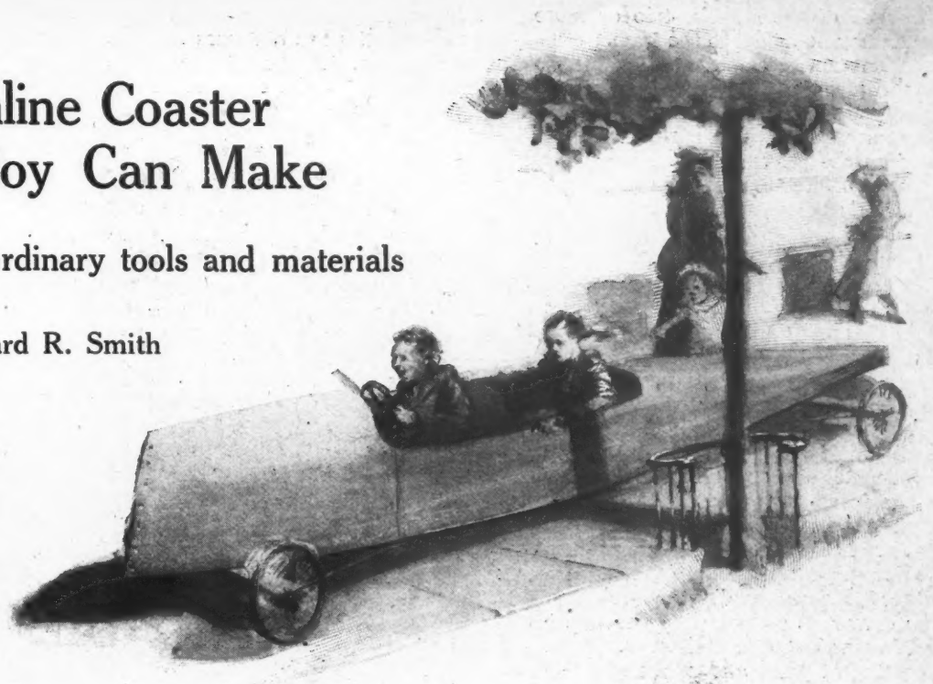
The illustration shows the operator applying stucco to a concrete wall. The machine may also be used on brick surfaces with equal success.

Other things besides cement can be hurled from this gun. It has been used for water-proofing the inside of a large pit, and may also be used for hurling pebble dash of any desired finish. It works very rapidly, coating about 450 feet of concrete in an hour.

A Streamline Coaster that Any Boy Can Make

It can be done with ordinary tools and materials

By Edward R. Smith



All boys like to coast, and they will be especially delighted with a coaster of this type. Easily constructed, it may be fitted out with automobile accessories that are inexpensive

WHEREVER there are long hills or level pavements of any length, the pushmobile and coaster appeal to the boy. The illustration shows a streamline coaster, that any boy can make. Designed for speed, it is strongly built, easily steered and controlled, yet very light. The materials can be purchased for a small sum. A hammer, saw, brace and bits, file or wire-cutter, and a jackknife are the necessary tools. In addition, a chisel, plane, pliers, monkey-wrench, nail set, automatic or breast drill, spokeshave or draw-knife, tin-snips, and square will be found useful.

Materials Needed for the Coaster

The following list of materials will be required for the construction of the coaster:

Three 10-ft. 4-by-½ or ⅝-in. pine boards.

Three 2½-ft. 1-by-4-in. boards for the axle and tongue.

Several short lengths.

45 ft. of No. 15- or 18-gage galvanized wire.

11 ft. of canvas of 4 ft. width.

One wire spring for the brake.

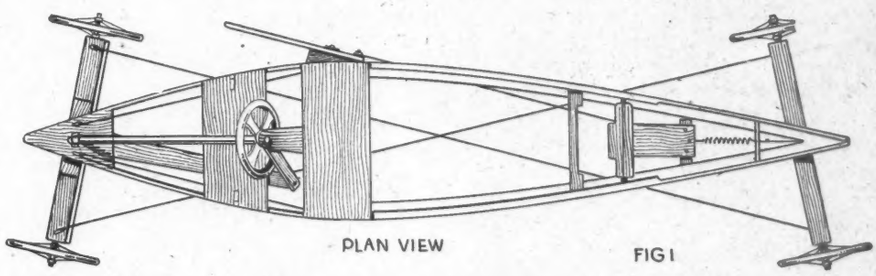
Four wheels.

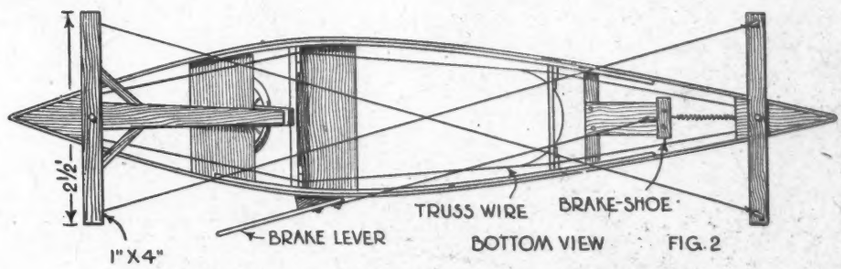
Nails, bolts, screws, and paint.

Build the Frame First

The frame of the coaster is built first. Three pieces of pine or some strong, clear wood, 4 in. wide, ½ or ⅝ in. thick and 10 ft. in length, are selected for the sides. Two of these must be sprung to shape as shown in Fig. 1 and 2. If they are stiff, they should be placed on a box or sawhorse and weighted at the ends, as shown in Fig. 3, then boiling water should be poured on the upper side of each piece. This will soften the wood so that bending will be easy.

To prevent splitting, make the nail and screw holes with a drill. Strips of tin will reinforce the frame-joints.





The chassis as it will appear before the body is attached

The third 10-ft. length is cut in half. These half lengths are nailed to cross-pieces, 1 by 4 in. and the other 2 by 4 in., cut to take a steering brace, Fig. 7. Truss-blocks should be fixed to these cross-pieces before they are nailed in place. The 10-ft. lengths are screwed or firmly nailed to the end blocks, and when dry, are bent around this inner brace, Fig. 8. The end blocks are sawed from 4-in. stuff, or built up as shown in Fig. 9 and 10. Number 15- to 18-gage galvanized truss-wires are hung beneath the frame and securely fastened on top of each end block. They are tightened by forcing them on the truss-blocks.

The wheels fixed to their axles, Fig. 11, are pivoted to the end blocks with a bolt, screw, or spike. Opposite ends of the axle are connected by equal lengths of wire, Fig. 8. To the front axle a steering tongue, Fig. 13, is fastened by means of metal or leather hinges. The steering wheel, Fig. 12, with its shaft and connecting arm, is fixed in place and pinned to the tongue. The tongue should swing clear of the axle wires, yet be low enough to follow a foot-rest nailed to the frame. Depending upon the

strength of the wheels, two or more seats may be nailed to the frame.

A friction pavement brake is next put in place. The brake-piece, swinging between parts of the frame and normally held up by a spring, is forced against the pavement by means of a lever connected to the drag with a wire. A shoe is bolted to the drag for ease in renewal.

Try It Out Before Proceeding

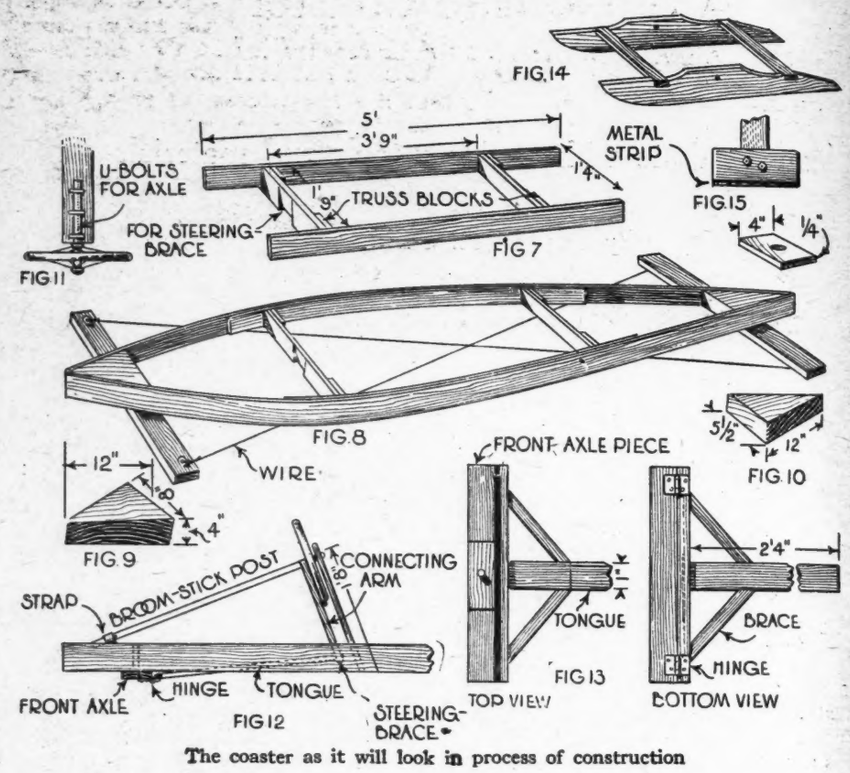
At this point a trial may be made to test the coaster. If satisfactory, it is ready for its casing or superstructure. This is made of canvas stretched over a wood frame. It is much lighter and more quickly and neatly put on than sheet-metal or wood. The dimensions of the frame are given in Fig. 4 and 5, while the canvas cut-out is shown in Fig. 6. It is better to make a pattern of newspapers pinned or pasted together to insure a good fit for the canvas. The canvas is stretched to the frame and fastened with carpet-tacks. With a coating of paint and, if desired, the addition of a horn, bell, or other form of road-clearer, the coaster is ready for service.

Within certain limits, dimensions and materials may be changed to meet the means and desires of the builder. It is a coaster, not a model motor-car. The hood conceals no motor, but rather protects the steering gear and the driver as it cuts the air. The after-decking allows the air gradually to close in. In short, it combines ideas in streamline design with extreme simplicity in construction.

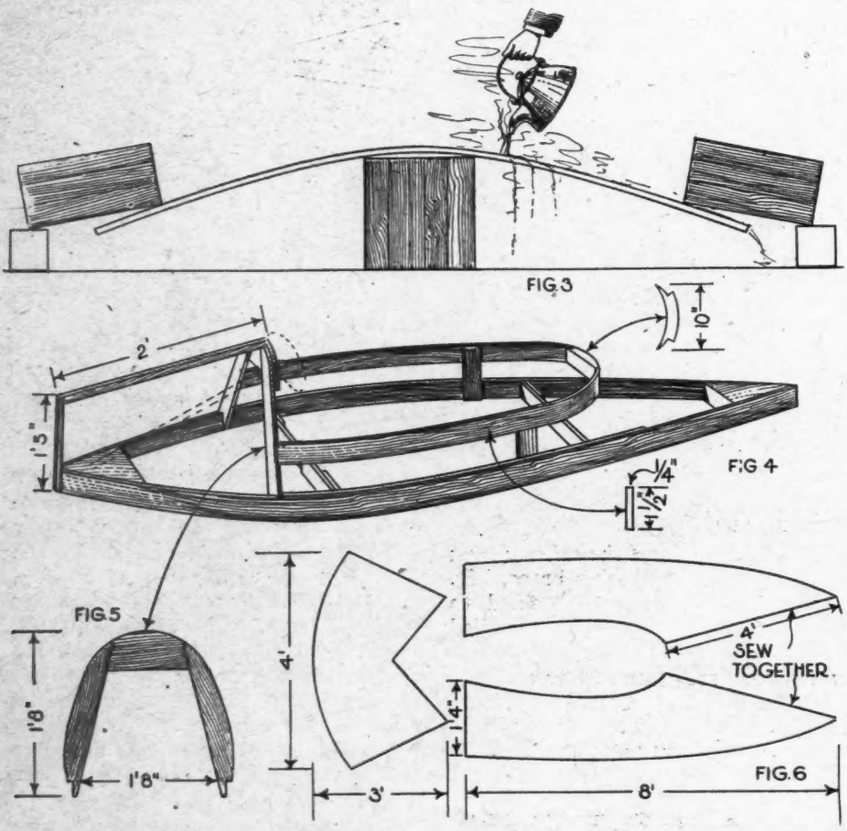
For winter coasting, runners (Fig. 14) may be fitted to the axles in place of the wheels. A special shoe (Fig. 15) makes the brake effective on ice and snow. Because of the fact that both axles turn, the center of the car runs parallel with the line of motion. With a motor wheel fixed to the frame at this point, a fair speed can be made on a level pavement. In winter it becomes a speedy motor-sled.

An air propeller provides a second method of propulsion. These motored propellers can be purchased, and if used must be mounted on a frame toward the rear of the car, with controls wired within reach of the driver. This, too, equipped with runners, will skim over ice or packed snow.

Thus, with a few changes and some additional expense, the boy living in a city may somewhat compensate for the lack of a convenient coasting hill.



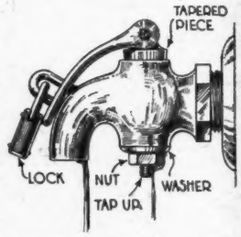
The coaster as it will look in process of construction



Steaming the boards, and the shape of the canvas when cut

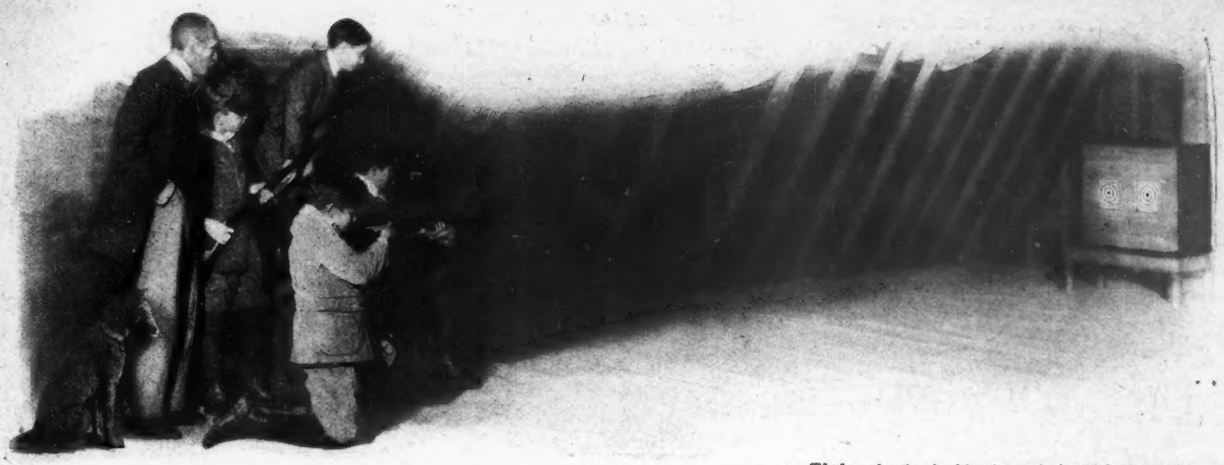
How to Get a Small Amount of Gasoline from a Locked Cask

AN employee carelessly carried the gasoline-barrel key to town with him instead of turning it in at the office. The faucet was similar to that shown in the illustration and the cask was full of gasoline and too heavy to be lifted and turned from its stand so that the top hole or outlet could be used. A rubber tube could have been used as a siphon, but there was none at hand.



In driving up tapered valve care should be taken not to strip threads of the valve

The gasoline needed was obtained in the following manner: The nut on the tapered piece was loosened, and the tapered valve driven up, and there was enough play to give two small streams of gasoline, which were caught in a quart measure.—H. W. HAHN.



The boy shooting in this picture is just a beginner; his form is a little awkward and cramped. By using his left knee to support his left elbow, his aim would be steadier.

A safe bullet catcher for indoor use

In standard use among the W. J. R. C. boys

Sharpshooter Medal

ONE of the safest bullet catchers to use in shooting is likewise the easiest to make, as proved by the number in use among Winchester Junior Rifle Corps boys.

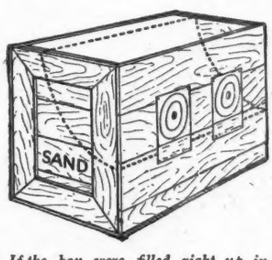
It's just this, a packing box banked up on the inside with sand.

This sand is what will stop your bullets. It should be very fine—no large stones. Fill the box as shown in the illustration. Bank it up to the top at the back and let it take its natural angle of rest, that is, the slope at which it stops sliding.

Now this makes the best possible backstop for indoor or outdoor use. Sand stops a bullet as nothing else will. Bags of sand are used on the parapets of trenches to stop the high velocity bullets of the regular army rifle.

To take care of the occasional wide shots of a beginner, there should be a larger backstop behind and around the main bullet catcher. This can be made of a large sheet of boiler plate—¼ inch thick and about 4 feet by 4 feet. This must be covered over with boarding at least ⅞ inch thick to keep the bullets from rebounding.

With such an outfit as this, you can shoot with perfect safety in your back yard, or if you live in the city, in your cellar or attic. You can enjoy in good or bad weather the fine sport of rifle shooting which every boy longs for and never outgrows.



If the box were filled right up in front, the sand would trickle out of every hole made by the bullets. The sand must be rebanked frequently as the bullets make it slide.

Start a W. J. R. C. "Unit"

The job of finding a place to shoot, rigging up a range and getting your rifles is always easier and cheaper *when you have a bunch of your chums in on it.* There's more fun, too, in the actual shooting when there are other fellows to compete with.

So why not get together with half a dozen of your chums, join the Winchester Junior Rifle Corps and organize a regular Unit or Club which will be officially recognized at National Headquarters. Any boy who gets a Unit started gets a Special Service Pin.

The W.J.R.C. will help you from start to finish in rigging up your range and in putting it on a paying basis.

The W.J.R.C. gives you all the instruction necessary to become a real expert in the use of a rifle. It provides for officers, supervisors, instructors to make your shooting safe.

It costs you nothing to join the W.J.R.C. There are no dues and no military obligations whatsoever. The W.J.R.C. was organized solely to encourage better marksmanship and better sportsmanship among boys and girls of America. It is intended to develop the qualities of fair play and manliness which are essential to success in after life. Any boy or girl not over 18 and who is in good standing in his or her community is eligible.

Membership in the W. J. R. C. covers the entire United States. There is hardly a town now that has not at least a small "Unit" of the big National Organization, where boys are learning to become expert riflemen and are competing among themselves for the famous Winchester Marksman and Sharpshooter Medals. You, too, can earn these trophies of marksmanship if you join the W. J. R. C. and start shooting now.

Walter J. F. Oeding, Alameda, Cal., winner of Winchester MarksmanMedal

Get the official plan and handbook

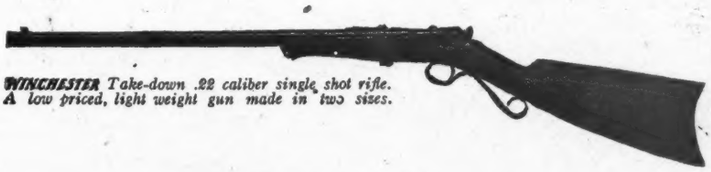
Write today for Winchester Junior Rifle Corps "Plan for Organizing a W.J.R.C. Unit," and for the official hand-book —"Rules of the Winchester Junior Rifle Corps" and "How to Handle a Rifle Safely." This booklet tells you all about the W.J.R.C. and describes in detail the fine points of shooting — alignment of sights, the 3 correct positions, rules for gun safety, the care of rifles, and the proper rifle for you to use.

If you are a boy scout, give your name in full, the troop you belong to and the name of the scout master. If you are not a boy scout, state what boy organization, if any, you belong to, giving the name of the official in charge.

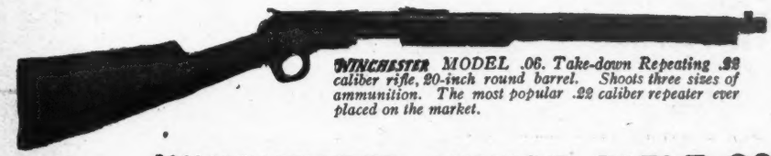
National Headquarters

Winchester Junior Rifle Corps

276 Winchester Ave., New Haven, Conn., U. S. A.
Division 320



WINCHESTER *Take-down .22 caliber single shot rifle. A low priced, light weight gun made in two sizes.*



WINCHESTER *MODEL .06. Take-down Repeating .22 caliber rifle, 20-inch round barrel. Shoots three sizes of ammunition. The most popular .22 caliber repeater ever placed on the market.*

WINCHESTER JUNIOR RIFLE CORPS

Winchester Junior Rifle Corps

National Headquarters, 276 Winchester Ave.
New Haven, Conn., U. S. A. Division 320.

Gentlemen:

Please register my name as a member of the Winchester Junior Rifle Corps, and send me a membership button and certificate of membership. Also tell me how to organize a Local Unit of the W. J. R. C.

Very truly yours,

*Name*_____

*Street Address*_____

*City*_____ *State*_____

A Good Scrap-Basket for a Sewing-Machine

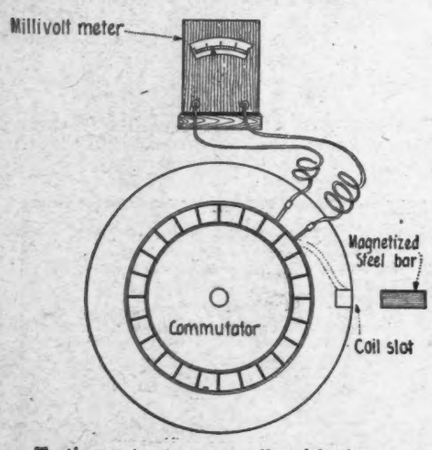
A NEW fish-basket makes a handy scrap-basket for the busy sewing-woman. The small hole in the top is at exactly the right place to catch bits of cloth and any threads

A fish-basket hung at the end of the sewing-machine to hold scraps of cloth and threads

that are clipped, and the holes in the back of the basket make it easy to fasten it to the side of the machine with a strap. The fact that it is off the floor saves labor and makes it inconspicuous.—C. P. FONDA.

Locating a Reversed Coil in an Armature

IN armatures where both leads of a coil tap to and lead out from a certain point there is danger of getting the leads crossed while making connections, thus reversing the direction of flow of the current in that coil. Such reversals in all cases "light out"



Testing out armature coils with the use of a millivoltmeter and magnetized bar

as if perfect when tested with a lamp, but will cause bucking when the machine is run.

A reversed coil of this sort is unusually difficult to locate, and very often a whole machine has to be stripped because ordinary methods of testing fail to locate the trouble. The most efficient test the writer has yet been able to discover, and one that has never failed to work, is illustrated in the sketch. It will be seen that a millivoltmeter is used rather than a voltmeter. This is because of the great sensitiveness of the former instrument.

Connect both terminals of the meter to adjacent commutator bars. Next, take a piece of metal that has been magnetized, and move it in a direction corresponding to the revolving of the armature and directly above the coil to which the meter is connected. It is well to keep in mind the fact that, if a clockwise motion is used on the first coil, the same direction must be retained on all the other coils, or the meter reading will be backwards.

On the downward stroke of the magnetized bar, and as it approaches the coil to be tested, magnetic lines of force will travel from the bar to the coil, thence to the meter, causing the needle to fluctuate slightly. If the needle jumps ahead on the downward stroke, it will jump on the upward stroke backward, and *vice versa*. The reversed coil will read opposite from the others. To change the direction of the fluctuations of the needle, either reverse the meter terminals or reverse the motion of the magnet.—MAURICE CLEMENT.

A Substitute for Storage-Battery Separators

IN rebuilding a storage battery, it was found necessary to replace the wood separators with new ones; but, as these could not be procured, substitutes were used which proved satisfactory and which were obtained at practically no expense.

A small packing-case in which a motor had been shipped, furnished the material. The sides of the case were three-ply veneer. These pieces were soaked in water for a time, and then the plys were carefully separated with a thin-bladed carving-knife. They were then dried between two boards to prevent curling up; and when dry the glue was removed with sandpaper. The final step was to soak them for a couple of days in diluted sulphuric acid before cutting. The veneer was 1/16 in. thick and was cut with snips.—JOHN A. WEAVER.

Here's a Flyer Sled Made to Drive by Hand-Power

THE owner of a flyer sled can make it into a hand-driven machine by means of the few attachments shown in the illustration. A shaft is

A hand-driven attachment for the flyer sled, made of bicycle sprockets and a chain

supported in front which has a crank on each end and a small sprocket-wheel attached to the center between the supports. Farther back is another bracket support for holding the crank-shaft and its bearings. This may be taken from an old bicycle.

Two long wood arms are used for the pushers. They are attached to the cranks on the first-mentioned shaft. The end of the pushers have claws made from cutters taken from an old mowing-machine. Any other thin piece of steel will do, as long as it is bent to take hold of the hard snow and ice.—DALE R. VAN HORN.

An Efficient Tool for Cutting Circular Gaskets

WHERE any quantity of circular gaskets are used or much circle-cutting is done, there is need of a cutter that will do the work both quickly and accurately. Such a de-

A home-made tool fastened to the bench-top; it cuts a gasket with one turn of the crank

vice can be made from materials usually at hand. One of these devices is shown in the illustration. It is adjustable to the various sizes needed in the work.—CHARLES H. WILLEY.

EVERY boy should have a voice in buying his own bicycle. It is a good lesson in business judgment. If he is a wide awake boy he has looked into the matter and done some investigating on his own. He has asked older boys particularly about tires because good tires are necessary to a good wheel.

An investigation like that will show that the big majority of experienced riders will say "Be sure it has United States Tires." They have found that these tires are always reliable, they resist punctures and cuts, they give longer mileage and do not need to be renewed so soon.

The boy with business instinct will learn that United States Tires are made and backed by the world's largest rubber manufacturer, and he will point out the U. S. Seal on each tire, which stands for quality in rubber goods wherever you see it.

Then when it comes to picking out the bicycle in the store, he will *know*, and he will insist on United States Tires.

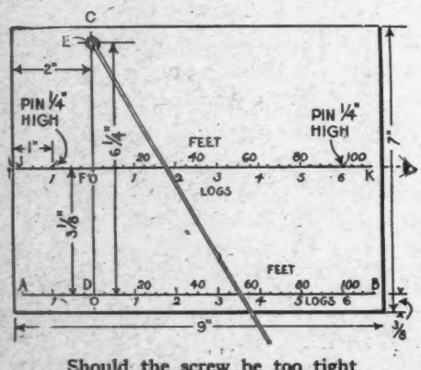
There are styles to meet every need—both clincher and single tube.

United States Cycle Tires are Good Tires

How to Make a Height Measure for Trees

AN instrument for measuring the heights of trees can easily be made at practically no cost. Take a piece of ½-in. board 7 by 9 in., and plane it smooth on all sides. Draw the line *AB* ⅜ in. from the lower edge and parallel to it. Draw the line *CD* 2 in. from the left end of the board and at right angles to *AB*. Make a mark at *E*, 6¼ in. from *D*, and another at *F*, 3⅛ from *D*. Now draw a line *JK* through *F* parallel to *AB*. Start at *D*, lay off inches and quarter inches on *AB* in both directions, marking *D* as zero and putting down the number of inches from *D* to each inch mark. Do the same for the line *JK*. Take a brad or small nail and drive it in carefully on the line *JK* about 1 in. from the edge of the board. Drive it in until the point comes out on the back of the board; then pull it out and drive it in from the back until the point sticks out about ¼ in. from the face of the board. File off or cut off with pliers any part of the brad that projects from the back of the board. In the same way, insert another brad near the other end of the line *JK*. These brads are the sights, and it is important that they be straight and true.

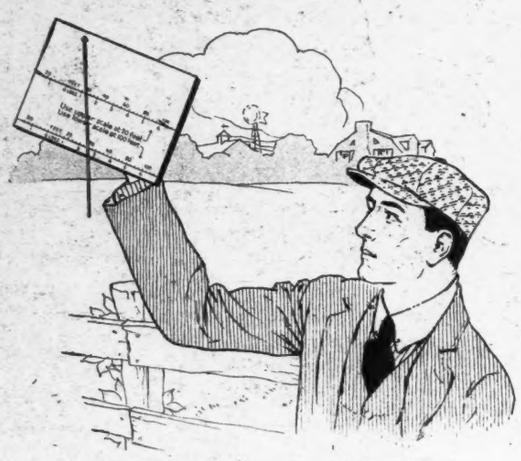
Take a piece of straight heavy wire 10 in. long, and bend one end of it into a loop about ⅛ in. in diameter. The center of the loop should be in line with the straight part of the wire. Fasten this piece of wire loosely to the board at *E* with a ½-in. screw, so that it will swing freely when the board is on edge. The loop should be large enough to fit loosely over the shank of the screw, but small enough so that it will not slip off over the head.



Should the screw be too tight the pointer will not swing freely

Screw a piece of wood about 6 in. long 1 in. wide and ½ in. thick to the back of the board to serve as a handle, and the height measure is complete.

To measure the height of a tree, stand at a distance of 100 ft. from it, and hold the instrument in the right hand in such a way that the pendulum swings freely but very near the board. Sight along the brads at the top of the tree and let the pendulum come to rest. Then with the left hand press the pendulum against the board without



If the board is not slightly tilted the reading will not be accurate

giving it a chance to change its position. Read off the number of feet in height on the lower scale. If the wire crosses the line 5 in. from the point *D* it indicates that the tree is five 16-ft. lengths or 80 feet high above the level of the eye.

Now sight at the foot of the tree and take another reading. If the pendulum hangs to the left of *D*, that is, between *A* and *D*, add the amount indicated to the first reading, and the result will be the total height of the tree.

Thus, if it hangs ½ in. to the left of D, add half a log or 8 ft. to the first reading, making a total of 5½ logs or 88 ft. But if the eye is below the foot of the tree, the wire will hang to the right of *D*,—between *D* and *B*—and then the amount of the second reading should be subtracted from the amount of the first. Thus if the first reading is 96 ft. and the second is 12 ft., —to the right of *D*—the total height of the tree will be 96 less 12, or 84 ft. If the tree is less than 75 ft. high, or if it is difficult to see the top at a distance of 100 ft., the observer should stand 50 ft. from the tree; but in this case the readings are on the line *J K*.

When the instrument is sighted, the pendulum can be kept in position by tilting the hand slightly to the right. This brings the wire against the board and holds it in place so that a reading can be obtained. Care should be taken however, so that the wire will not slip after the board is tilted.

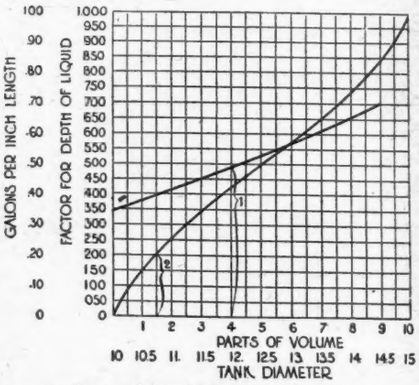
In the example given the total height of the tree has been measured. It is often of more practical importance to measure the height to a point on the tree beyond which there is no merchantable saw timber. This measurement is made in the same way as that described, except that the instrument is pointed at what will be the top of the last log when the tree is cut, and then at the point where the top of the stump will be.

You Should Have a Gasoline-Tank Gage-Stick

MANY an automobile-owner whose car has a gasoline tank without a gage for recording the fuel gallons in it has wished to have a simple stick which would enable him to estimate the contents of the tank quickly. The accompanying chart, prepared by the Society of Automotive Engineers and published in that Society's data hand-book, will enable them to figure out the volume of any cylindrical tank placed horizontally, and to calculate the distances on a stick to correspond with any number of gallons.

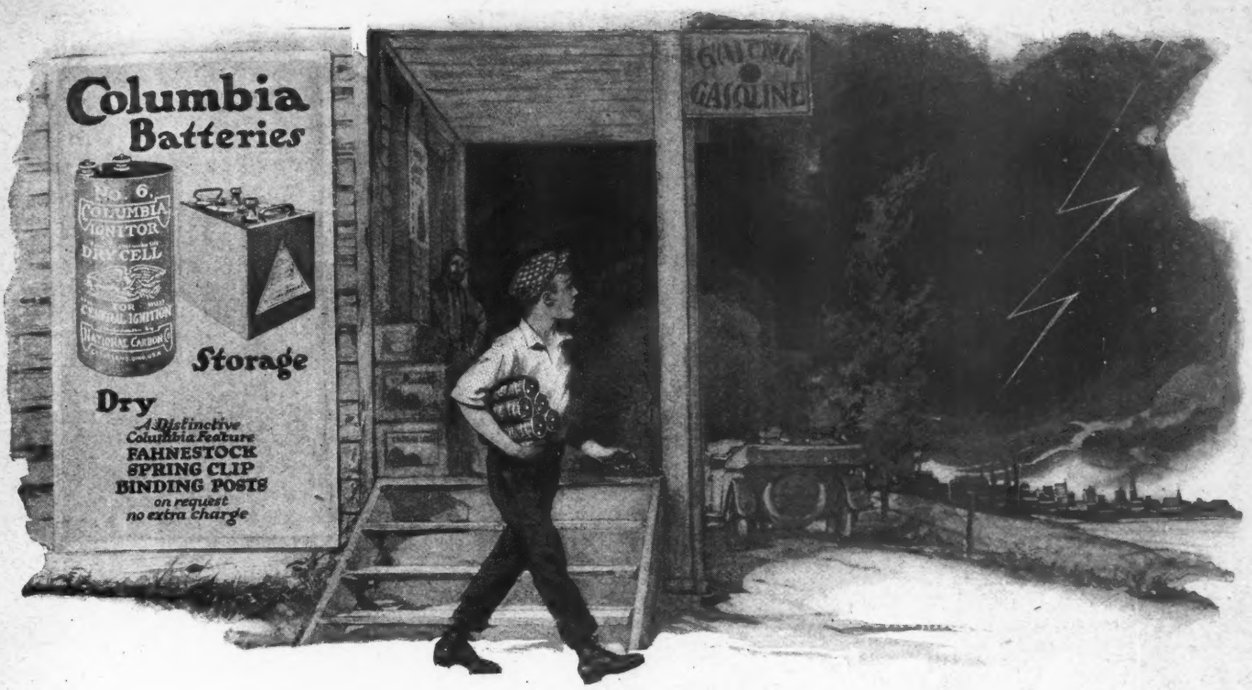
Suppose you had a car with a tank 12 in. in diameter and 40 in. long, and wanted to know how many gallons of gasoline it contained when full. Read along on the bottom scale until the figure 12 is reached, then trace a line vertically to the point 1 and note that it cuts the curve marked "curve of gallons per inch of length" at .49, reading on the left scale of gallons per inch of length. Multiply this factor of .49 by 40, the number of inches in the length of the tank, and the total volume of 19.6 gallons is obtained.

Next, suppose that for the same tank you want to make a stick showing the number of gallons in the tank corresponding to any level of the fuel in the tank. For instance, let us find where to mark the stick if there are three gallons in the tank.



A chart with which one can estimate the contents of a gasoline tank quickly

First find the decimal proportion of the number of gallons taken to the total volume. This gives 3 divided by 19.6, which equals .153. Then on the horizontal chart labeled "parts of volume" find the point .153, and move your pencil up vertically to the point marked 2 where it intersects the line marked "curve of depth factor of liquid." Multiplying this unit of .213 by 12, the depth or diameter, gives 2.556 or 2 9/16. in. The mark to indicate that three gallons of fuel are in the tank should then be put 2 9/16 in. above the bottom end of the stick.—J. B. BRINKER.



The Mighty Thunder Cloud and the Fiery little Columbia are first cousins

THE mighty thunder cloud often generates and wastes 150 thousand horsepower, when it hurls its terrific bolt flashing and crashing through the sky.

The fiery little Columbia generates a fraction of this volume, but sends its power on a specific errand, through wires, under control, without waste.

It is electricity in both cases. But the mighty thunder cloud works at the command of Nature for an unknown purpose. The fiery little Columbia works at your command for a definite use.

THE DRY BATTERY

THE Columbia Dry Battery is the handyman of the world. It ignites stationary engines, autos, trucks, tractors, and motorboats; rings bells and buzzes buzzers; lights lanterns and makes telephones talk; runs toys for the youngsters.

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THE Columbia Storage Battery is so hale and hearty it is guaranteed to do definite work for a definite time. Its health certificate even stipulates that another battery will be put to work for you without additional cost if the original should fail within the guarantee period.

A unique plan is back of this Columbia Storage Battery Service. Any Columbia Service Dealer will test, charge, or water your battery. But if surgery is necessary, he will pass it along—with its seal unbroken—to a nearby Columbia Service Station, where only competent experts will open it and remedy it. This plan heads off tinkering—which, as you motorists know, is responsible for half your battery troubles.

Columbia Service Dealers or Service Stations anywhere will be glad to demonstrate why and how you—like legions of other automobile owners—will prosper with Columbia Quality and Service.

Columbia Storage and Dry Batteries

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You may have your choice of more than 2,000 instruments for a week's trial in your own home. Play it as if it were your own. Then, if you wish, you may send it back at our expense. Trial does not cost you a penny. Don't miss this big offer.

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If you decide to buy you may pay the low manufacturer's price at the rate of a few cents a day. The name "*Wurlitzer*" has stood for the highest quality for nearly two centuries. Every known musical instrument sold to you at direct-from-the manufacturer's price. We've supplied U. S. Gov't with trumpets for 55 years.

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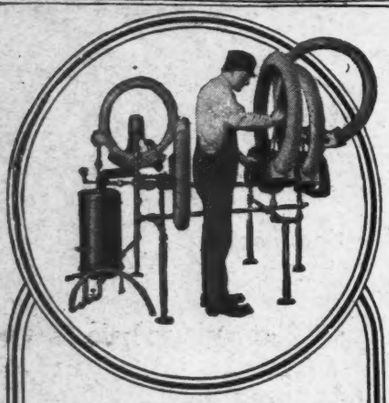

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Automobile Tire Surgery. There isn't a business you could get into that offers such sure possibilities of **success and fortune.** One man and a Haywood Equipment can make $250 a month and more. Scores already have done it and this year there is a greater demand than ever for tire repair work.

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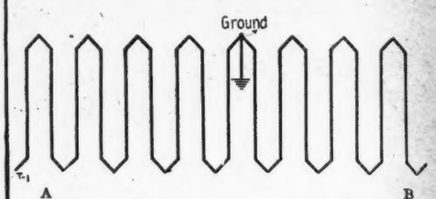
Locating Grounds on Alternating-Current Circuits

IN case a ground develops in an alternating-current armature or field, a resistance measurement will generally give the location at which it occurs.

The resistance measurement is taken as follows: Measure the resistance of the ground circuit, or phase; next, measure the resistance to the ground by connecting one line to it; then measure the other end of the resistance to the ground, connecting one measuring line at the other terminal of the phase and one to the ground. Assuming accurate measurements, the sum of the latter two will equal the first, and the ground will be as far from one terminal as the resistance from that terminal to the ground is of the total resistance of the phase.

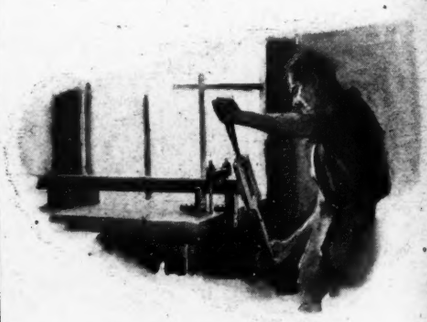


Illustrating an alternating circuit in which an unknown ground is to be located

The accompanying figure illustrates this explanation. If the total resistance between *A* and *B*, the two ends of the circuit, or phase, is one ohm between *A* and the ground is .45 ohm, and between *B* and the ground is 55 ohms, the ground is located 45-100 of the distance from *A* to *B*. If, for example, there are ten coils per phase, the calculations and measurements show that the fifth coil is grounded, counting from *A*.—PETER CLUTE.

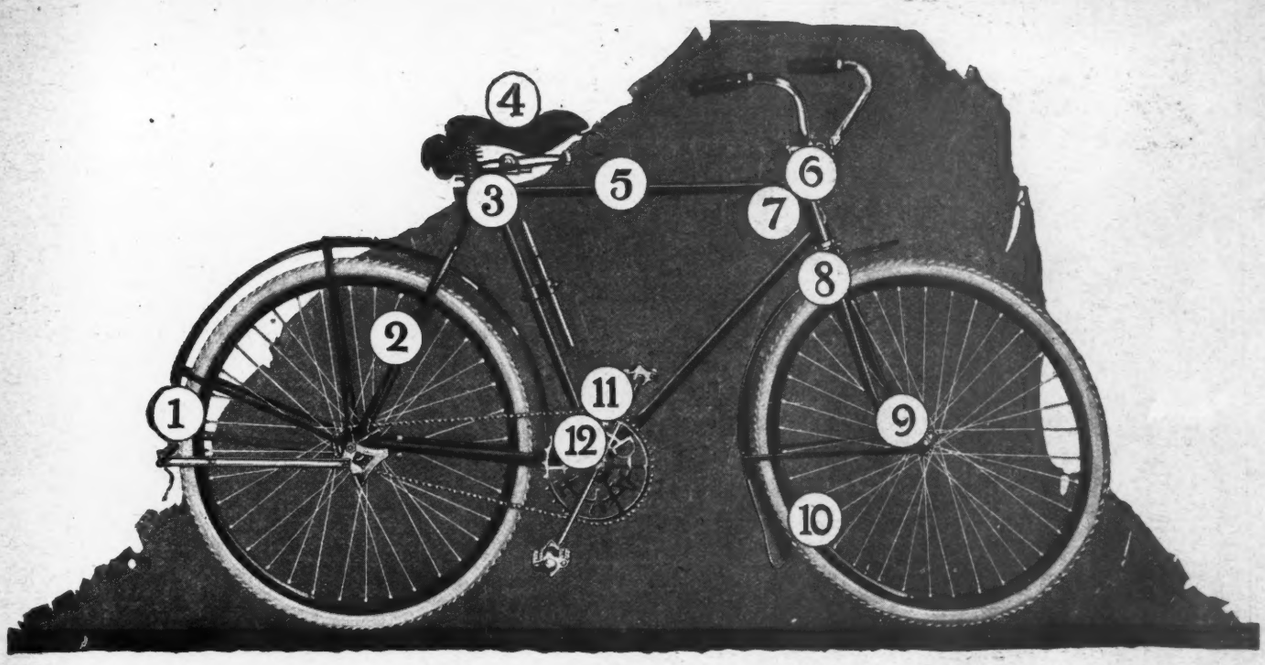
A Very Serviceable Pipe Vise Made from Scrap

THE illustration shows how to make a very satisfactory pipe vise from old scrap junk. The lower jaw is made in two pieces from ¼-in. flat iron, the material being bent as indicated, and the notches for the pipe grip cut and filed. Holes are drilled



The scrap-iron vise set up

and these jaws secured to the bench. The upper jaw is made of a single piece with two straps riveted across it. This, with two long bolts, completes the vise.—CHARLES H. WILLEY.



1 Front and rear mudguards, splash protector and stand on all models.

2 Special design rear fork giving extra clearance between wheel and fork sides. Flush rear fork ends.

3 Drop-forged seat-post cluster, giving extra strong grip on seat-post.

4 High-grade padded leather saddle with double action springs. Leather tool bag and complete tool equipment.

5 Seventeen process enamel finish of Dayton Carmine. Tough and long wearing. Heavy coat of copper under all nickel plating.

6 Dust-proof head adjusting cone. Extra large High Duty ball bearings. Cones case-hardened in cyanide.

7 Outside joint head construction. Eleven inner reinforcements in frame, all dip-brazed.

8 Double anchored fork sides with solid steel spool between plates.

9 Front hub and cups of special design turned from solid steel bar. Two-point frictionless bearings.

10 Vitalic DeLuxe or Kokomo Everlaster tires. Selected maple rims.

11 One-piece drop-forged cranks. Hobbed sprocket.

12 Seamless crank hanger bracket, extra reinforced.

THERE are good reasons for the acknowledged superiority of Dayton Bicycles. A few of them are stated above. Study them! It is points such as these that mark the difference between a bicycle that merely looks good and a bicycle that actually is good.

Dayton Bicycles are designed and built with painstaking care. They embody every known and tested feature of design and construction that can make for beauty, simplicity, efficiency, durability and comfort.

A Dayton Bicycle may be purchased with absolute confidence in the real satisfaction it will give and in the actual economy it will effect.

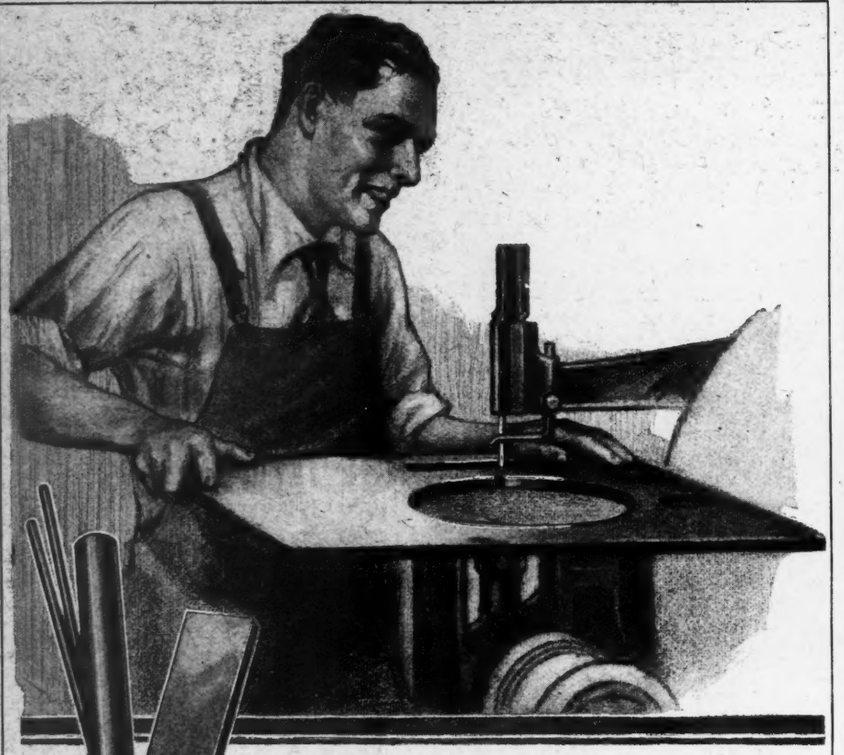
There are eight models in the fine new 1919 Dayton line—a bicycle to meet any need. Each Dayton Bicycle bears the "Davis-Made" trade-mark—which is a reminder and a pledge of quality. Dayton dealers will gladly show you the Dayton line. See your Dayton dealer—and write to us for our new Dayton Catalog. It is free. Ask for Catalog B.-7.

Cycle Dept., THE DAVIS SEWING MACHINE CO., Dayton, Ohio

THE DAVIS SEWING MACHINE CO. DAVIS MADE DAYTON, OHIO.

We Back This Trade-Mark With Our Reputation

Dayton Bicycles



Fibre *for* Reconstruction!

THE war is over, but the battle of keen competition is just beginning. Reconstruction abroad means reconstruction at home. Success is based upon efficiency and efficiency begins with the raw material.

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represents progress—a step forward in the industrial field. Here is a modern material (in sheets, rods, tubes or special forms) that will stamp, drill, punch, thread, tap, turn or mill. It contains no grit or edge-nicking elements and can be machined with but little wear on tools. It can be had rigid or flexible, is almost indestructible and will withstand severe vibration without crystallizing.

It is strong, tough, homogeneous, non-conductive to electricity and remarkably high in tensile, compression and shearing strength. It will take a high natural polish or can be finished with paint or varnish. Its easy workability saves overhead. Its light weight saves freight.

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Soldering Large Vertical Cables by the Pouring Method

TO solder any metals and make a good joint, it is quite necessary to bring the metal to the temperature of the melted solder. Large cables cannot be heated well with a torch or soldering iron, and for these the pouring method is generally used. To do this properly it is necessary to have a form through which to pour the metal. While it is passing it heats the cable.

For this purpose a piece of leather may be cut to the shape of a funnel, with a strap attached to hold it around the cable. The illustration shows the pouring of the solder, with the kettle set to catch it as the molten solder

A labor-saving means of pouring solder that assures an even temperature

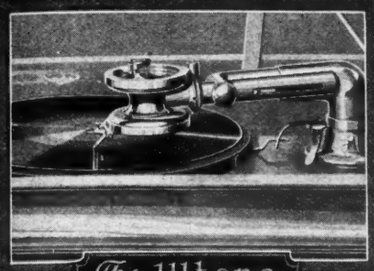
flows through. A small leather spout may be attached near the bottom of the funnel for running out the solder.—ELLIOT C. HARRISON.

A Good Way to Keep Paint-Brush Handles Clean

A JOB of overhead painting has some objectionable features, and one of them is caused by the paint continually running down over the brush handle. The picture herewith shows how a few pieces of tin can be formed into a simple catch or trap for the paint and soldered to the brush ferrule. It is worth the small amount of time required for making it if the painting is to cover any area at all. It insures a clean handle.—F. W. BENTLEY, JR.

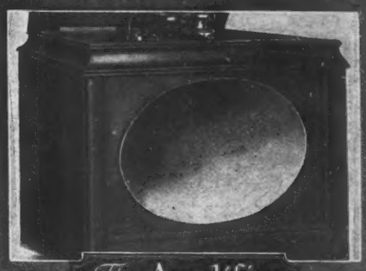
An indispensable device for the amateur painter

The BRUNSWICK Method of Reproduction



The Ultona

The Brunswick
ALL PHONOGRAPHS IN ONE



The Amplifier

Two New Ideas
Which Won Millions of Friends

WHEN the now famous Brunswick was announced, most people believed that the utmost had already been attained in the phonographic art.

Hence they expected, and rightly so, that The Brunswick would have to bring out overwhelming betterments in order to win a place among the leaders.

And this great expectation was realized. The Brunswick created a memorable sensation. It commanded instant respect and admiration.

The Pioneer

Of the major instruments, The Brunswick was the first to play *all* records with faithful regard for different requirements. This feature alone created thousands of admirers. For it meant that a Brunswick owner could buy and play *any* record, whatever make.

Since different makes offer different artists, and no one make offers them all, music lovers saw in The Brunswick the opportunity to select their own library of records, without restriction.

The other outstanding Brunswick betterment was in tone production. By a more scientific amplification of tone waves, The Brunswick overcame many old time crudities and brought out lovely tones hitherto lost.

Today The Brunswick Method of Reproduction is a recognized triumph. It means perfected reproduction to all who know it. And the news is spreading fast.

Two Famous Ideas

The Brunswick Method of Reproduction includes the Ultona, an all-record player. This master invention can be obtained on no other phonograph. The Ultona presents to each make of record, the proper needle and diaphragm. All at a turn of the hand. It is a unique reproducer, not an attachment nor makeshift.

The Brunswick Method also includes The Brunswick Amplifier, an all-wood sound chamber built with scientific regard for acoustic laws. No metal is used because it muffles sound vibrations.

Before you decide *which* phonograph for your home, hear The Brunswick. Compare its tone. Note the Ultona.

A Brunswick Dealer will gladly assist you in making a tone test.

The Brunswick-Balke-Collender Co.
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Electrical Devices and How They Work

XV.—Dynamo and Motor Troubles

By Peter J. M. Clute, B. E.

IN the following paragraphs are enumerated the usual and common troubles occuring in the operation of dynamos and motors, with their causes, symptoms, and remedies. They are given in the order in which they are most likely to occur, and it will save time to test for causes in the order listed. It is well in all cases, not to jump at conclusions, but to make a careful examination first. Since the

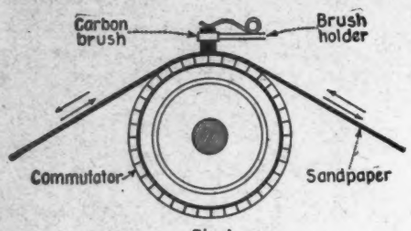

Fig. 1

Method of Sandpapering Brushes to Prevent Sparking

construction of direct-current generators is essentially the same as that of direct-current motors, most of the troubles inherent to one are also encountered in the other; in other words, the remedies for generator and motor troubles are quite similar.

Slop or Failure to Start

1. Fuse melted or blown. Open switch, take out blown fuse caused by short-circuit and put in new fuse.

2. Dead line. Test for the current at the switch.

3. Broken wire for connections. Open line switch, locate and repair the break.

4. Poor contact of brushes or insufficient tension on the brushes. Clean commutator and see that the brushes touch, adjusting tension to secure a light, firm, and even contact.

5. Heavy overload. Reduce load on motor to its rated capacity or less.

6. Excessive friction. Armature rubs, bearings run hot, or the belt is too tight.

7. Short-circuited field or armature. Locate and repair, if possible. Carefully examine all insulation on connections and brush-holders. Defective insulation, dirt, oil, and copper or carbon dust often cause short-circuits.

Failure to Generate

1. Residual magnetism weak or destroyed. Use magnetizing current from another machine or a battery through field coils in proper direction to correct fault. Test polarity with a compass. If this fails, shift the brushes backward to make the armature magnetism assist that of the fields.

2. Reversed field connections, so that one half of field opposes the other half. This can be detected with a compass.

3. Defective brush contact. This may be due to dirt or oil on the commutator, brushes not properly trimmed, insufficient brush tension, brushes in wrong position, or a rough, worn commutator surface. Remedies can be found hereafter under "Sparking at the Brushes."

4. Short-circuit in the external circuit. External short-circuits or grounds prevent building up of shunt or compound generators.

5. Short-circuit in machines. Test for location of trouble, examining the insulation carefully.

Sparking at the Brushes

1. Brushes not set on neutral. Shift the brushes back and forth until sparking is reduced or eliminated.

2. Brushes not set diametrically opposite.

3. Brushes not in line. Adjust each brush until its bearing is on a line with the commutator bars.

4. Insufficient brush contact. Due to dirty commutator or poor tension, allowing the brushes to leave the commutator.

5. Commutator has high, low, or flat bars, projecting mica, or may be rough and worn. Grind with fine sandpaper and polish. If defect is serious it may be necesssary to turn the commutator true.

6. Open circuit in the armature. Sparking will occur only at one place on the commutator, thus indicating the location of the break. Defective coil may be temporarily repaired by connecting to the next coil across mica. Permanent repair should be made as soon as possible.

7. Short-circuited or reversed armature coils will cause the motor to draw excessive current, even without carrying a load. Reversing field coils can be located by a compass. Shorted coils will usually burn out under load, and should be removed, while reversed coils may be connected properly.

Heating of the Armature

1. Excessive heating of armature coils is due to over-loading or too much power being taken from the machine.

2. Armature coils short-circuited. Locate the defective coil and remove the cause, which is either poor insulation or moisture. If it is the latter, dry out the armature before starting. This may be done by sending a low current through the winding, or by causing the machine to generate a small current itself by running slowly.

3. Cross-connection is often caused by a loose coil-abraiding on another coil or the armature core.

4. Reversed coil or coils. Locate with the aid of a compass and reconnect correctly.

5. Faulty armature construction. Wires too small, eddy or Foucault currents, hysteresis may be among the causes.

6. Insufficient ventilation, allowing armature to heat up unnecessarily.

The Heating of Field Coils

1. Voltage at which machine is operated may be much higher than it was designed to turn out or receive.

2. Field connections may be wrong. They may be in parallel when they were intended to be in series. A part of the field may be cut out by either a ground or improper connection of the wires in the coil.

3. Excessive field current. In the case of a shunt or separately excited machine, the terminal voltage should be lowered to reduce the speed, or the resistance of the field can be increased by putting resistance in series. In a series machine, decrease the field current by means of a shunt or rewinding with coarser wire.

4. Moisture in the coils. Resistance of field circuit will be lower than normal. Dry it out as in the case of the armature.

Heating of the Commutator and Brushes

1. Heat may be conveyed to the commutator from the other parts of the machine, namely, the armature or the bearings.

2. Sparking at the brushes. If the

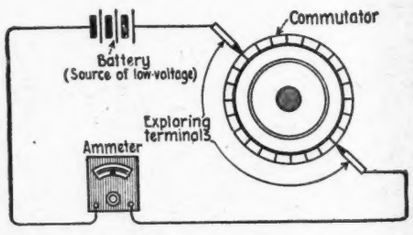

Fig. 2

Testing for open Circuit in Armature with Ammeter

heating is due to the sparking, investigate for the cause.

3. Poor brush-holder contact. The holder should not be so tight that it will prevent full tension on the brushes for a good contact.

4. Brushes heated by excessive current. Brushes must fit commutator and be properly spaced. Use either

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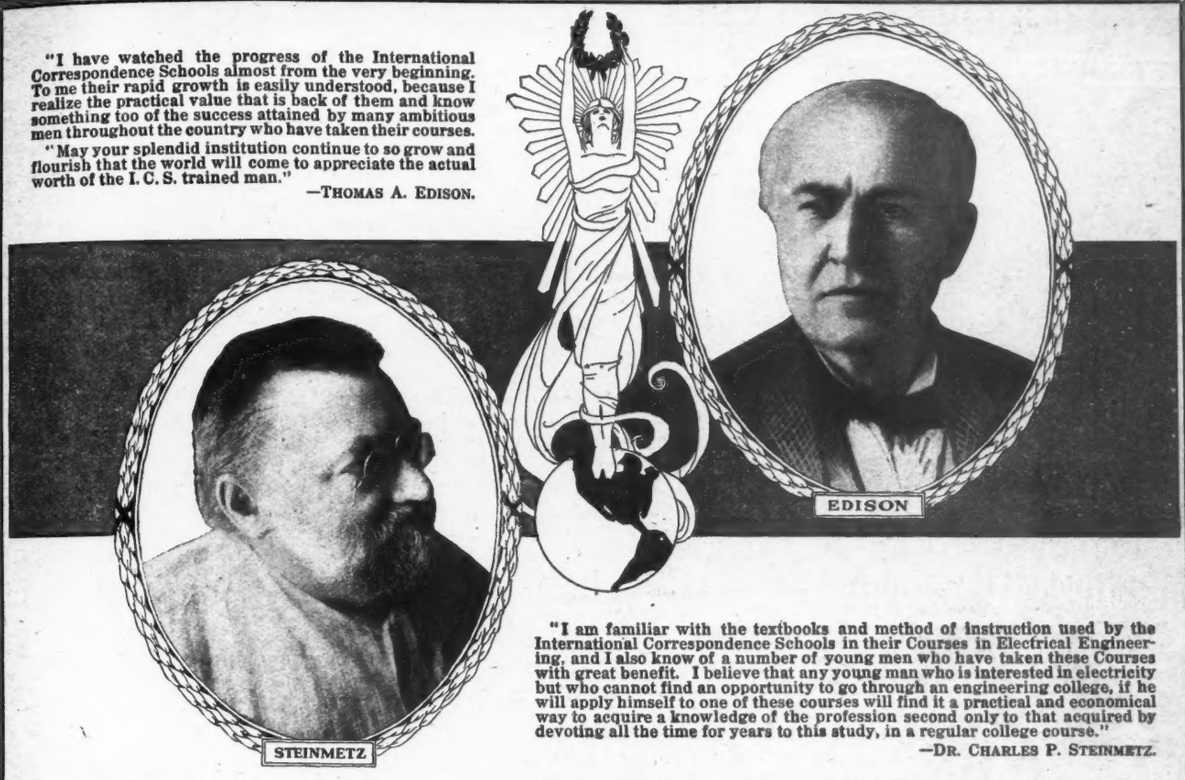

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larger brushes or lower resistance brushes to remedy this trouble.

Heating of Bearings

1. Excessive belt tension, which makes the pulley bearing the hottest. Reduce load so that the belt may be loosened and yet not slip on the pulley.

2. Insufficient or a poor grade of oil in the bearings. Only plenty of good, clean mineral oil should be used.

3. Mechanical faults, such as a failure of the oil rings to revolve with the shaft; dirt, grit, chips, or filings in the bearings; rough journal and bearing seats; a bent shaft; journals too tight in the bearings; bearings out of line; too much end play, due to improper leveling or no lateral shaft motion; unequal air gap, caused by the armature being out of center of the poles.

Motor Runs Too Fast

1. A series motor races away when the current is too great. Series motors require constant regulation, if connected to a variable load; a light load causes a motor to speed up.

2. A shunt motor will run too fast if the field rheostat is not properly set, or if the proper current is not supplied to the motor. In either the field rheostat adjustments should be made.

3. Light fields, grounds, and short circuits will allow the motor to speed up unless heavily loaded.

4. Improper connections, such as the field coils, may be in series instead of in parallel; part of the field winding may be connected so as to oppose the other part; the compound coils may be in opposition to the shunt coils.

5. Speed too high, and with all resistance in the circuit the voltage is still above normal. To remedy this, additional resistance must be inserted in the circuit, unless the speed can be cut down by some other means as, before mentioned.

Motor Runs Too Slow

1. Excessive load on the motor. Reduce the load to the rated capacity or less. Locate and remedy any unnecessary friction or mechanical resistance.

2. Short-circuited windings in the armature. Test for cross-connections or short circuits, and, if such is found, rewind the armature to correct trouble.

3. Armature strikes or rubs on the pole pieces. Locate projecting coils, and after pressing them down into place secure them with tie-bands. Striking may be caused by the bearing placed out of line or the armature out of center of the pole pieces.

4. High brush resistance and friction. Clean, reset, and fit the brushes to the commutator.

5. Weak magnetic field, due to a broken circuit, short circuit, or the machine not properly wound.

6. Fields may be too strong. Fields designed for series connection may be connected in parallel, causing them to run hot.

Motor Running in Wrong Direction

1. Runs backward, wrong direction. Reconnect correctly according to the diagram. If no diagram is available, reverse connections to the brushes or make other reversals until the direction of rotation is correct. Try reversing connections of fields or armatures. If both are reversed, it will have no effect. As long as the polarity of the fields and the armature remain in the same relation to each other, the polarity of the supply circuit is immaterial.

2. Multopolar motors can be reversed by shifting the brushes so that the negative brushes take the place of the positive.

3. Two-phase motors are reversed by reversing the wires of one of the phases.

4. Three-phase motors are reversed by changing any two of the line wires.

Noises

1. Armature out of balance. Should have been balanced before assembly.

2. Armature rubs or strikes the field poles. Locate the fault and remedy the trouble. Striking may be caused by projecting coils; bearings out of line or armature out of center of pole pieces. File out pole pieces where the armature rubs or strikes.

3. Noisy bearing. Grit or dirt in the bearings. Oil rings may not run properly.

4. Too much end play, allowing collar on the shaft to knock against the bearing housing.

5. Brushes hum or sing. Clean commutator thoroughly, and sand the brushes to fit the commutator with a firm, smooth, gentle pressure.

6. Flapping or slipping of the belt. Tighten the belt or reduce the load on the machine.

Miscellaneous Troubles

1. Fuses blow at starting. This may be due to a fuse of too small rating, or to loose or dirty fuse clips; motor overloaded; motor armature stuck; starting resistance cut out too fast; short circuit in the armature or the field; grounded line; improper connections; or the field circuit may be open.

2. Heating of induction motors is generally due to one of the phases being open. It must be remembered that a three-phase motor will continue to run on one phase, but will not start single phase. If such a motor is overloaded it will come to rest and burn out.

3. A short circuit may be caused by two grounds in a two-wire system, or by one ground in a three-wire system with grounded neutral.

4. Shocks obtained from touching the machine frames are always due either to static electricity or the

grounding of some live part of the system on the frame of the machine. Static electricity is caused by the belting, and can be remedied by providing an arrester. Grounding may be either to the shaft or to the machine frame.

General Care of Machines

In general, the motor or dynamo, and all control devices connected with its operation, should be kept properly cleaned. No dust, dirt, or copper or carbon dust should be permitted to accumulate, inasmuch as they will eventually cause insulation breakdowns. Bearings should be kept clean and free from dust and dirt or grit and the oil should be renewed frequently. The brushes should be kept smooth and set, sanded to fit perfectly, the curve of the commutator, to eliminate sparking and consequent pitting and scratching of the commutator.

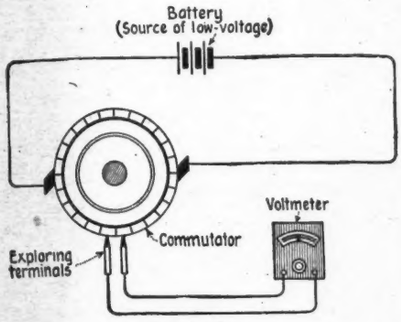

Fig. 3

Testing an open-circuited armature with a voltmeter

The foregoing gives briefly some of the more important points that will undoubtedly prove of value in the care and operation of direct-current motors and dynamos. Alternating-current machines do not require as close attention as direct-current machines, because the commutator of the latter is the chief source of trouble. Only the more important and common faults and troubles arising in connection with direct-current machinery are given, the less common and less frequent troubles being found and encountered on complicated systems of wiring and special designs of machines.

The present article is the concluding one of the series dealing with electrical devices and the principles involved in their operation. Means and methods of locating and repairing faults and troubles inherent in direct-current electrical machinery will be readily apparent upon reference to any standard electrical hand-book. By following explicitly the procedures given, troubles can be eliminated at once, and at the same time preventative measures will suggest themselves as one becomes familiar with the operating characteristics of the machine in question.

[THE END]

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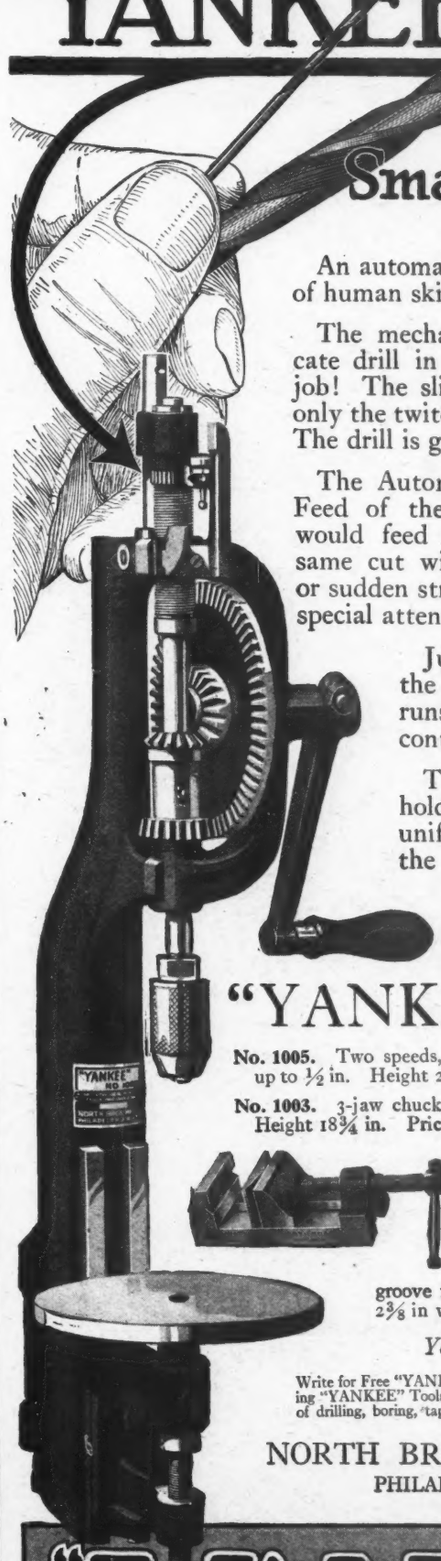

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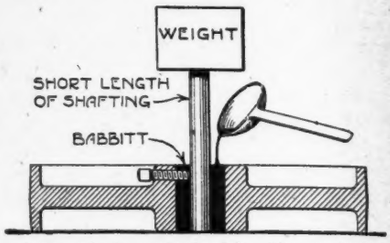
When set, place a weight on top. It



A practical method of bushing quickly

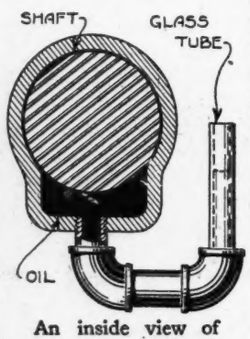
is then ready for filling the space with whatever material is at hand—lead, old babbitt, or type metal.

If the shaft has been coated with black or red lead it should pull out of the new bushing by hand, and the latter be ready for use on the regular shaft without scraping or reaming. In the illustration the set screw will be seen extending through the space to be filled with babbitt up to the shaft.

By coating this screw with lead and setting it as shown, threads will be formed in the new bushing. With ordinary care a 24-in. pulley that is so bushed should run true within 1/32 in.—DONALD A. HAMPSON.

A Home-Made Sight Oiler for a Bearing

THE arrangement illustrated was attached to all bearings in hangers of a large plant, and it assured the oiler that there was a supply of oil in the lower chamber. Each oiler consists of a 3/8-in. gas-pipe fitted as shown with a 2-in. length of ordinary gage glass cemented with plaster-of-Paris in the ell.



An inside view of the oil-gage as it will appear when finished

The oil in the glass tube will always show the level of the oil in the reservoir. The bearing can be oiled from the opening at the top of the glass gage.—THEODORE J. BECKER.

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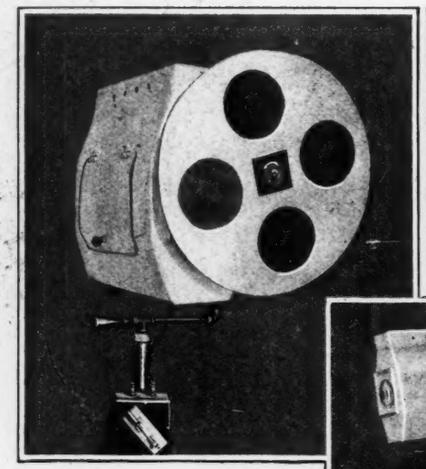
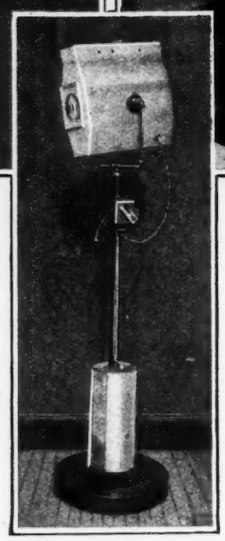
A Spot-Light for Amateur Theatricals

Make One for Your Dramatic Club

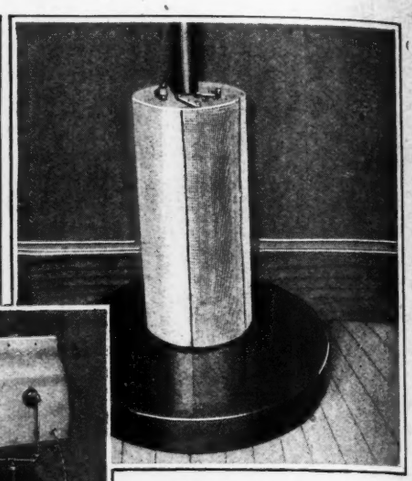
By Raymond Francis Yates



Front of the lanterns with the revolving disk attached for the colored lights



The lantern complete mounted on its base

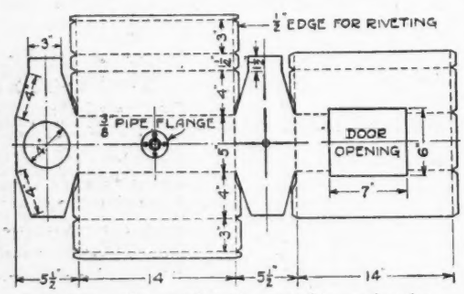


The base which encloses the rheostat and the switch to control the current

THE spot-light described as follows is of simple construction, and makes an ideal machine for the local dramatic club, or to produce moonlight effects at dances and receptions. In fact, an alert builder could easily make the lamp pay for itself by renting the machine.

The lamp-house is made first. It is cut from No. 22 gage galvanized iron in a single piece, as shown. The dotted lines indicate where the iron is to be bent. After bending into the proper shape, the house should be riveted together with ⅛-in. copper rivets. It is, of course, understood that both the hold for the lens and the large opening on the side for the door are cut before the lamp-house is bent into shape. A ⅜-in. pipe flange is bolted to the side of the lamp-house to accommodate the iron pipe that holds it.

A piece of 1-in. iron pipe is used to form the standard of the machine. To the lower end of this is fixed a heavy wood base made of two thicknesses of 1½-in. plank, glued together with the grain crossing. Unless the builder is provided with the proper tools for making this circular wood base, it should be ordered from a mill where the work can be done. The base should be made large enough and with sufficient weight so that the machine will not be topheavy.



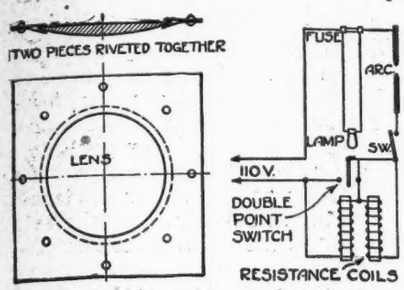
Patterns for cutting the metal to make the lamp-house. When bent to the proper shape one piece makes the entire box

Two small wood circles are then cut to form the top and bottom of the compartment at the base of the machine, which incloses the resistance coils and the electric light. As shown, the compartment is built around the standard, and it will be necessary to drill a hole in the center of each of the circles so that they will fit snugly on the 1-in. iron pipe standard. After the resistance coils and the lamp are in place, two pieces of galvanized iron and two pieces of wire screen are tacked to the wood blocks. The wire screen is used to insure good ventilation, since the resistance coils generate considerable heat.

Two lengths of ⅜-in. iron pipe, two els, and a tee-joint are then assembled to form the angle that supports the lamp-house on the standard. This is shown in the sketch. The el on the upper end of the angle is fitted with a short length of pipe connecting with the flange previously bolted to the side of the lamp-house. A swivel-joint is then made between the iron standard and the iron pipe angle, so that the lamp-house may be turned.

A 4-in. single-convex lens is mounted between two pieces of galvanized iron, as shown. Two grooves are then bent from sheet iron and riveted to the front of the lamp, so that the frame in which the lens is mounted will slide in

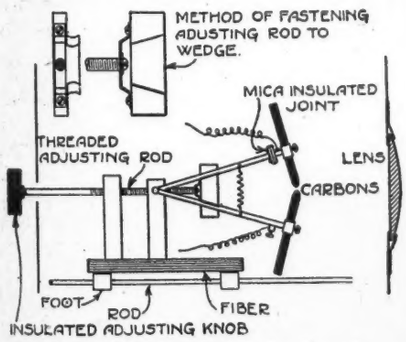
them. If the builder is unable to obtain a single-convex lens of this size, a smaller one can be used, or a piece of ordinary glass can be fitted to the front, although this would decrease the range of the machine. When the vent-holes in the top of the lamp house are fitted with iron strips, so placed on the inside as to prevent the escape of light and yet to permit free circulation of air, the machine is ready for the electric fixtures.



The lens or condenser mounting and the wiring diagram for the current

The arc light and its mechanism will be considered first. This is simplicity itself, being formed of two brass arms, joined at one end with a screw and with the carbon holder at the other, and provided with a spring, which pulls them together. The regulation of the arc is effected by means of a metal wedge, which forces the brass arms apart or permits the spring to pull them together, depending on which way it is moved.

The arc mechanism is shown in the sketch. It will be noticed that no dimensions are given, since a general description will enable the builder to make it with the materials and facilities at hand. The whole arc mechanism is mounted on a fiber base equipped with four feet, which are provided with a hole so that the base can be



Mechanical arrangement for controlling the carbons to bring the space to an arc as the carbons are burning

made to slide on two steel rods running the length of the lamp house. This arrangement is made to focus the light.

Two small resistance coils are wound on asbestos strips and mounted on the compartment at the base of the lamp. A socket and carbon filament lamp is also placed in the compartment, and, after the proper connections are made, the sheet iron and the wire screens are tacked in place as previously explained.

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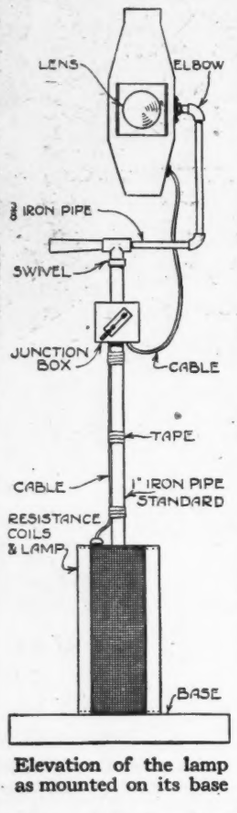
The wires from the coils and lamp are brought through porcelain insulators and formed into a single cable by winding friction tape around them. This cable terminates in a small junction box which contains a fuse connected in series with the arc, and a small single-pole switch is mounted on the cover.



Elevation of the lamp as mounted on its base

The fuse is also shunted across the lamp in the compartment at the base. When the fuse blows, the lamp can be used to provide a light to make repairs by bringing the carbons together and connecting the lamp in the circuit. In case the resistance burns out in operation, an external resistance can be used by disconnecting the coils by means of the two-point switch mounted on top of the housing for the resistance coils. When the arc is started, both coils should be in the circuit, and to bring the lamp to full brilliancy one coil should be short-circuited after the arc is struck.

The method of connecting the electrical apparatus is shown in the diagram. The arc is connected to the junction box by a cord that runs through a fiber bushing in the lamp house. An ordinary lamp-cord and plug complete the electrical equipment of the machine.

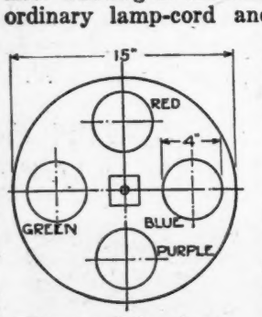


Diagram of the circular disk for the colored lights

The machine is made complete by the addition of a color wheel made of galvanized iron and provided with four holes each 4 in. in diameter. Squares of colored glass are placed over the holes and fastened to the back of the wheel by means of single strips into which they slide. A shaft is fixed to the center of the wheel, which fits into small bearings on the lamp house so that the color wheel can be made to revolve in front of the lens at the desired rate.

If it is desired to spread the light, the arc-lamp carriage should be moved to the front of the lamp house, and if a concentrated beam is desired it should be moved to the back of the lamp house. In spreading the beam by moving the arc forward, it should be remembered that it is quite possible to break the lens by excessive heat; therefore the arc should not be brought too close to the lens. A limit should be provided for the movement by arranging an object on one of the rods on which the carriage slides.

Locating an Invisible Error in an Alternating-Current Motor

WHILE working in a power plant in a small town, the writer was called to reconnect a three-phase four-pole series star-connected motor so that it would operate at different voltages.

Changes were made according to blueprints, but when the motor was tested it operated at one-third normal speed.

To locate the trouble, the star connection was opened and opposite ends of each phase joined to the terminals of a storage battery. By testing the poles of the armature with a small pocket compass while the current was flowing as stated, it was found that the poles of each phase were symmetrically placed around the armature, and that they were alternately marked *S*, *N*, etc.

Next, the star connection was joined again and the current allowed to flow in two leads and out the third. Under this condition, and with a properly connected three-phase four-pole motor, the polarity of three consecutive poles should be in one direction, while that of the next three should be opposite, etc., thereby forming four flights of alternately different polarities. In this motor, however, it was found that the adjacent pole faces of different

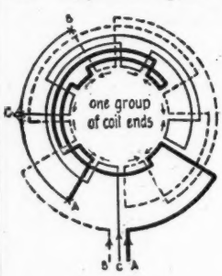


Fig. 1

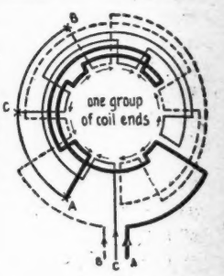


Fig. 2

The trouble was that adjacent pole faces of different phases had opposite polarities

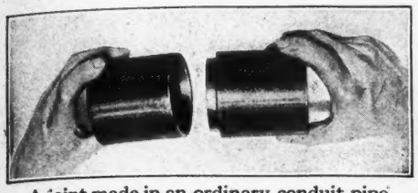
phases had opposite polarities, indicating that one phase was removed.

To determine which was reversed, all of the leads were connected with the positive terminal of the storage battery, while the star connection was joined with the negative terminal. As shown in Fig. 2, the polarities fell in three flights of opposite values. In a properly connected armature polarities of adjacent poles should be opposite.

Since the only polarities that could be reversed to bring about this arrangement were those corresponding to phase *B*, it indicated that this phase had been reversed; that is, the terminal that should have been a lead was connected to the star points, and *vice versa*.—MAURICE M. CLEMENT.

A Fiber Conduit Used as a Drain-Pipe

THE ordinary fiber conduit used by electricians for insulating electric wires may be converted into drain- and leader-pipes by using conduits having walls ½ in. thick and the ¾-



A joint made in an ordinary conduit pipe so that it may be used for a drain-pipe

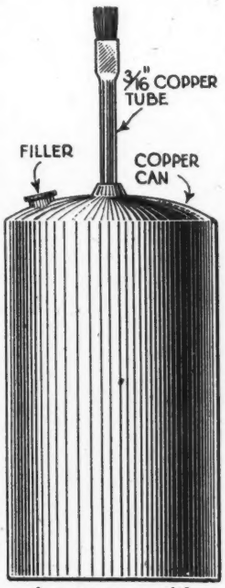
in. tenon joint, as shown. This joint permits one section to slip over the next, making a very tight joint. These connections may be made doubly secure by the use of waterproof cement. A leader hook is used to secure the fiber leader-pipe to the wall, as well as to keep it away from the wall.

A fiber leader-pipe may be made of wood fiber, saturated with a special waterproof material, and, as there is no metal in it, the leader cannot rust.

In the present scarcity of metal, this substance is a good substitute, and, as it cannot rust and will not rot, it ought to last for an indefinite period. Then, too, the pipe may be laid in the ground the same as a tile and it will still have its lasting qualities. In laying the pipe the joints should be protected to keep them from breaking.—LOUIS CUMMINGS.

A Soldering Acid Receptacle with a Brush Spout

SOLDERING acid may be conveniently applied by means of the combined can and brush shown in the illustration. An ordinary copper can about 2½ in. long by 1½ in. in diameter is used, and it is provided with a neck made from a piece of 3/16-in. copper tubing. Into this tube some paint-brush bristles are inserted, being made fast by flattening the neck. The degree of this flattening determines the flow of the acid and a very delicate adjustment can be made by this means. There is a filler plug in the top of the can, so that more acid can be added.—ERNEST SCHWARTZ.



A copper can with a brush nozzle

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THOUSANDS upon thousands of old automobiles which had been cast into the discard as too old and too incomplete for satisfactory service were seen on the streets during the last six months of 1918, and many are still merrily chugging their way over our thoroughfares, each giving some service to mankind which is better than no service at all. Automobile authorities estimate that it will be at least nine months before all of the factories are turning out cars at their before-the-war rate.

Many remarkable transformations were made in old cars called out of retirement. Here was an old-timer with a chariot-type body fitted with an ingenious kind of closed body for winter use; there, a new carbureter which brought the miles per gallon up from five or six to nine or ten.

Many of the improvements and adaptations are important and practicable enough to warrant their being continued. It is in this belief that the POPULAR SCIENCE MONTHLY has decided to offer the substantial total of $300 in prizes for the three best methods of enabling the old passenger automobile to continue in service until, like the one-horse shay, it falls to pieces in its every part.

Rules of the Contest

ONE—The utilization of the old passenger car may roughly be divided into two main classifications: *a*—The continued use of the vehicle as a mode of transportation; and, *b*—The use of the vehicle to perform some function in a better manner, in less time and more cheaply than the same function can be performed by hand.

TWO—In determining upon the prize-winners, the judges will pass on each classification as of equal importance and will make the awards in the order in which the utilization or adaptation is of the most value or the greatest good to the largest number of people, no matter whether such utilization or adaptation be a mode of transportation or mode of power application.

THREE—The utilization or adaptation submitted for consideration need not have been in actual use, although if it has been put into actual use it will receive the preference as a deciding factor, when, in the opinion of the judges, two or more utilizations or adaptations are of equal value or good to the greatest number of people in all other respects.

FOUR—Contestants are not limited in the number of utilizations or adaptations they may submit. However, only one can win the first prize, one the second prize, and one the third prize. The contest is open to everyone.

FIVE—The utilization or adaptation submitted must be clearly shown in one or more drawings, or photographs with explanatory drawings, if necessary to bring out the method of arrangement or construction. The drawings must be intelligible, although it is not necessary that they be made by a skilled draftsman. Contestants are requested to make any drawings submitted in ink on stiff board rather than in pencil on writing paper. In each instance, the drawings should be as large as may be necessary to convey the idea clearly.

SIX—The contestant's name and address should appear on each drawing submitted. Each drawing or set of drawings on any one idea must be accompanied by a description in which the utilization or adaptation is clearly indicated. This description (preferably typewritten) must be written on one side of the paper. The name and address of the contestant must appear in the upper left corner of the first sheet of the written description.

SEVEN—The description and drawings submitted by any contestant must be received in the office of the POPULAR SCIENCE MONTHLY not later than 12 o'clock noon, Saturday, March 1, 1919. All contributions received after 12 o'clock noon on March 1, 1919, will not be considered in awarding the [illegible] will be returned to the contestant if return postage is sent.

EIGHT—A first prize of $150 will be awarded to the contestant who, in the opinion of the judges, has submitted the utilization or adaptation of an old passenger automobile which is of the greatest value or good to the largest number of people.

A second prize of $100 will be awarded to the contestant who submits the utilization or adaptation next in the order of merit.

A third prize of $50 will be awarded to the contestant who submits the utilization or adaptation which ranks third in merit.

NINE—The winners of the prizes will be announced in the May, 1919, issue of the POPULAR SCIENCE MONTHLY.

TEN—The description and illustration of the utilization or adaptation which wins the first prize will be published in the May issue of the POPULAR SCIENCE MONTHLY, together with the name and address of the winner. Similarly, the second and third prize uses will be published in the June and July issues respectively together with the names and addresses of those winners.

ELEVEN—The judges of the contest will be the editors of POPULAR SCIENCE MONTHLY.

TWELVE—The editors of the POPULAR SCIENCE MONTHLY shall have the right to publish at regular space rates descriptions of utilizations or adaptations which do not win any of the prizes but which they consider of sufficient interest for publication.

THIRTEEN—The full property rights in any utilization or adaptation submitted are retained by the contestant, the only restriction imposed being that defined in Rule 12.

FOURTEEN—If a contestant submits more than one utilization or adaptation, each must be sent as a separate unit.

FIFTEEN—Address the descriptions and drawings submitted to the Motor Contest Editor, POPULAR SCIENCE MONTHLY, 225 West Thirty-ninth Street, New York City.

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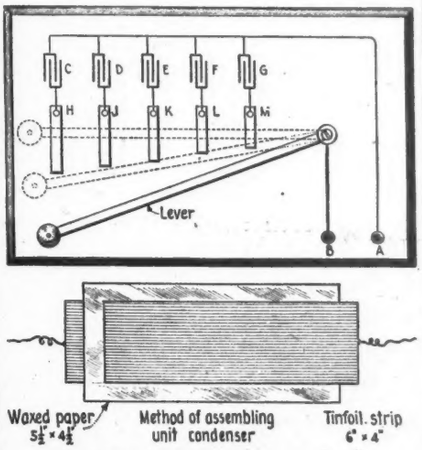
How to Make a Small Variable Condenser

THE condenser shown in the sketch herewith combines the capacity of a fixed condenser with the gradual capacity variation of a variable one.

It is suitable for a wireless receiving circuit, or to shunt around a vibrator of an induction coil, by making the units considerably larger.

It is made up of several fixed condensers connected in parallel, a lever being the means whereby the capacity is varied.

Five or more units may be used, each being a small condenser built up of ten sheets of waxed paper and nine sheets of tinfoil. A convenient size for the tinfoil is 6 by 4 in., and for the paper 5½ by 4½ in. The latter should be a good grade of thin linen paper, and should be very carefully dipped in paraffin. The sheets of the tinfoil and the paper in each unit are piled up alternately, allowing about ½ in. on each tinfoil strip to project beyond the paper for connections, as shown.



Several fixed condensers connected in parallel and arranged to be variable

The pile is covered with heavy paper, and a heated flat-iron is passed over the top of each unit until the paraffin begins to melt. Upon cooling, the units become compact.

The connections necessary are shown in the sketch. The condenser units *C*, *D*, *E*, *F*, and *G*, each have one side connected to a common terminal, *A*. The other side of the condensers are connected to the copper strips *H*, *J*, *K*, *L*, and *M*. They are ½ in. wide by 1/16 in. thick, varying in length, as shown.

A copper lever, ⅛ by ½ by 8 in. long, is pivoted at one end, so that it will connect two or more condensers in parallel. The pivoted end of the lever is connected to the terminals *B*. The dotted lines show different positions of the levers corresponding to variations in capacity.

The apparatus is mounted in a wooden box.—PETER J. M. CLUTE.

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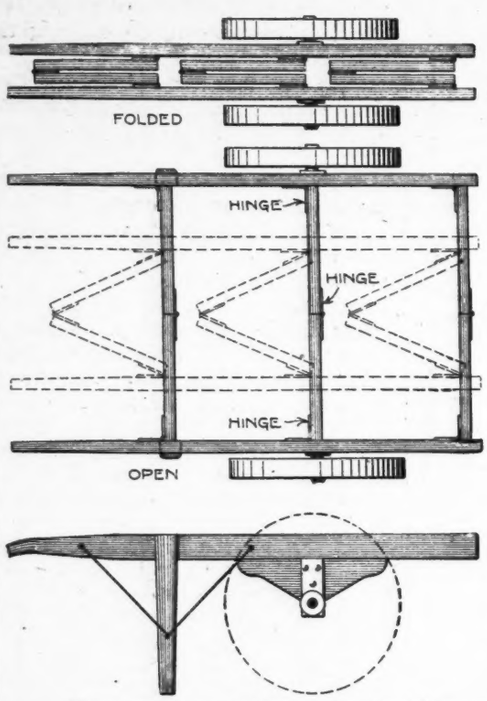
A Folding Hand-Cart to Pass through Doorways

THE accompanying illustration shows a hand-cart, which when not in use can be folded up so as to pass through any ordinary doorway. The parts are framed together in such a way that there is no need for taking down or loosening any of the joints. Simply fold the bottom of the cart upwards and then the sides fold together carrying the wheels closer but still leaving them so that they will roll along and carry the cart. The plan view is shown clearly. The framework consists of the sides with three cross rails, each in two parts, hinged together as shown.



The cross pieces of this cart are hinged in such a manner that it can be folded for storing or passing through a small doorway. The bed holds the parts in a rigid position and keeps the cart from collapsing when it is being used

The side pieces are shaped with hand grips on each end and are finished with shaped blocks on the underside to raise the body of the cart to a convenient height. The framework is shown here folded together.

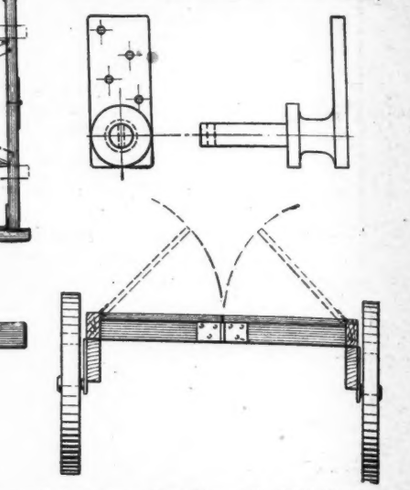
The axle for each wheel is forged as shown in the elevation. These pieces are fastened on the underside of the shaped block attached to the frame. The vertical part should be long enough to extend over the frame piece. When locating the axle pieces they should be placed opposite the center of the middle cross piece in the frame.

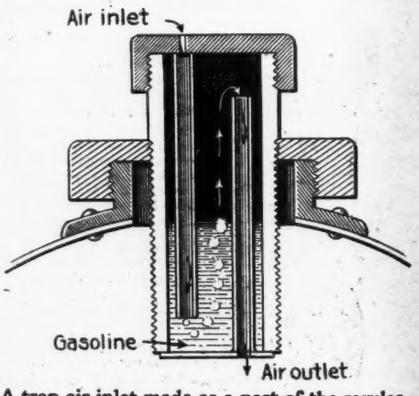
When the cart is extended out ready for use the sides are held apart because the bottom of the cart is a neat fit between the side pieces of the frame. For convenience the bottom is made in two pieces, each hinged to the sides of the cart as shown in Fig. 4. The cart opened out and extended for use with one half of the bottom partly opened is shown here together with the cart closed.—JOHN Y. DUNLAP.

This Tank-Cap Air-Vent Saves Gasoline

MORE than 200,000 gallons of gasoline is wasted daily in the United States through evaporation from the tanks of automobiles. The tank must be open so that air may enter as the fuel is used out. After gasoline vapor has collected in the tank, as it does especially in hot weather, it escapes through this air-vent. The device described herein will admit air and prevent this loss of vapor.

Thread a piece of ⅜-in. pipe about 2 in. long at both ends, as shown. One end should be closed by soldering over it a sheet of copper or tin. Drill a hole at one side of this end plate, and solder into it a tube about 1½ in. long, as illustrated. Solder or screw the pipe into the tank-filling cap. Drill a cap to fit the pipe at one side with a 1/16-inch drill, and over the hole on the under side of the cap solder a small tube about 1½ in. long. Then fill the pipe to a depth of about 1 in. with gasoline and screw the cap on tight.



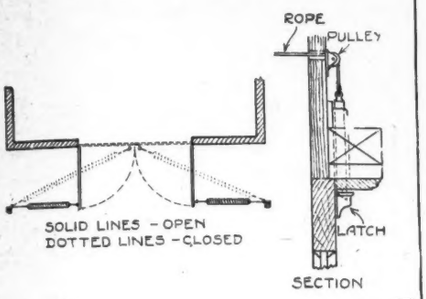


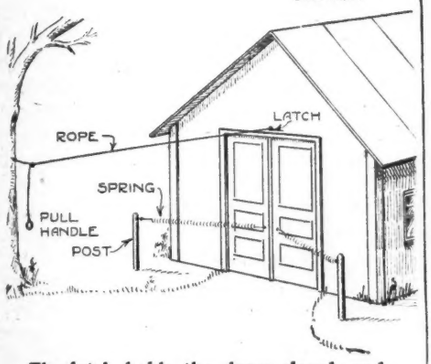
A trap air inlet made as a part of the regular tank vent to prevent gas from escaping

When a vacuum is created in the tank, the air will bubble through the gasoline; but the gasoline vapor will not be permitted to escape. The pipe should be filled with gasoline when necessary.—S. E. GIBBS.

Open the Garage Doors without Getting Out

THE illustration shows the means of opening the doors of a private garage from the driver's seat of an automobile as it approaches the entrance. Simply pulling the cord releases the catch, and the two spiral springs open the door.





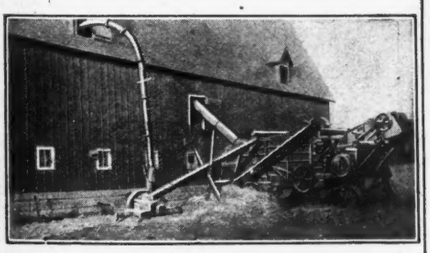
The latch holds the doors closed, and when released the springs pull them open

Each spring is attached to a door, and the other ends to the two posts set in the ground on either side of the driveway. An eye-bolt is placed in the top of each post for holding the end of the spring. The details show the construction of the latch and how the springs are attached.—P. P. AVERY.

An Ensilage-Cutter Used for an Elevator

WHILE threshing an oat crop it was desired to store the straw in the mow of the barn. To facilitate this, the pipe from the stack-blower was run into the mow and the straw was blown in.

In order to do away with the work of sacking and carrying grain to the bins, an ensilage-cutter, with its blower, was used to drive the grain directly from the thresher to the bins. The cutter was operated by a stationary gasoline engine.—JOE HALLIGAN.



A gasoline engine provides the motive power for the ensilage-cutter in elevating grain

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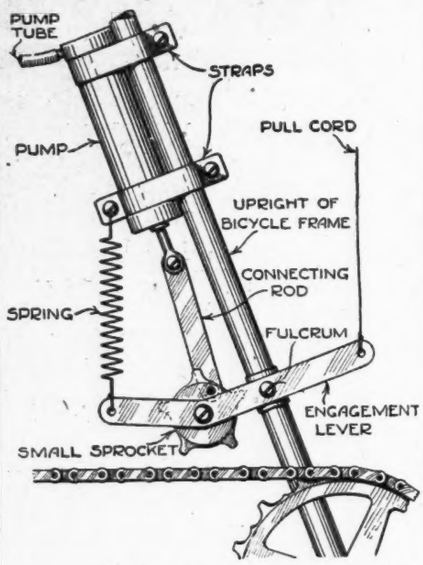

The pump and its driving parts are attached to the seat post tube of the bicycle frame

First, make the engagement lever the shape illustrated and bore one hole at the angle and another half way between the angle and the end of the long arm. Then drill two small holes at ach end. Mount this lever upon the upright post of the bicycle just forward of the rear wheel in such a position that when the small hole in the end of the short arm is in a horizontal position with the pivot bolt the sprocket wheel at the angle will clear the bicycle chain by about ½ in. The sprocket is arranged to turn freely and the lever is so fixed that it will swing easily upon its pivot. This pivot can be arranged to strap securely to the frame by means of metal bands attached to a block of hard wood.

Now, at a proper distance to give a good stroke, strap a common bicycle pump above this lever with piston rod pointing down. Flatten out the end of the rod and drill in it a 3/16-in. hole. Connect this rod to the sprocket with a connecting rod of strong metal. The sprocket should be previously drilled near the edge to make this connection. The whole thing must of course be arranged so that it will line up correctly with the chain.

A weak spiral spring should be attached to the hole in the short arm and carried to a point above, which will hold the sprocket at the proper distance above the chain and a pull cord tied to the other end of the lever with which to engage the sprocket. This can be carried to the handle bar or near the seat, as preferred.

By pulling on the cord the sprocket is forced down upon the chain where the teeth engage and cause it to turn as long as the pedals are being revolved.

Consequently, the piston of the pump is operated, forcing a blast of air wherever desired. This, of course, is best done while the rear wheel is off the ground and the bicycle resting upon the stand.

The Rolling Hoop or Wheel for Children

THAT mere man has long been addicted to idle smoking and chewing is commonly known; but less often is it observed that the idle carrying or swinging of something is almost as deeply rooted a characteristic. This may be traced from the crude club of primitive days to the gnarled and crooked stick and the fine and fancy canes and walking-sticks of to-day, which serve no purpose, but simply seem to afford their habitual carriers a sort of comfort and satisfaction in handling. Even the soldiers of to-day carry "swagger-sticks"—obviously too short for support, too light for a weapon, and with no pretense to usefulness.

Neither have women been exceptions to this habit—from the slender beribboned staff of the Colonial dame to the handsome little stick carried by the stylish woman of the present day.

Likewise, children exhibit this same characteristic in an even more marked degree. There is a strong attachment between the country lad and his reed or switch, which is almost always with him; while the city boy has his stick, with which he rattles fences, barrels, etc. There have also been a line of moving devices, such as hooples, of various kinds—all of which gratify an innate desire apart from the one that craves the passing plaything. In this connection, the hoop shown here has two novel features.

Boys love to roll hooples down hill. Here is one which can be simply made by any boy

It is made of solid wood—a barrel-top will do. The stick is fastened to the hoop. As the boy runs down hill with the stick in his hand, the barrel top revolves.

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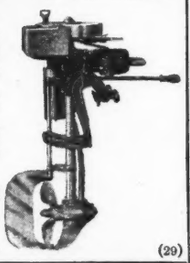

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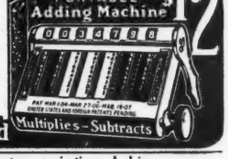

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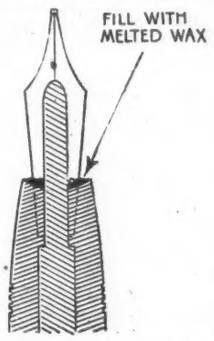
To Repair a Leaky Fountain-Pen Quickly

SOMETIMES a fountain-pen unexpectedly springs a leak at the base of the quill. A repair that will do the trick, and that will answer for a considerable length of time, is to run a little melted wax, sealing-wax, or soft chewing-gum around the insert of the pen. Clean that portion of the pen thoroughly before attempting to seal it.—L. B. ROBBINS.



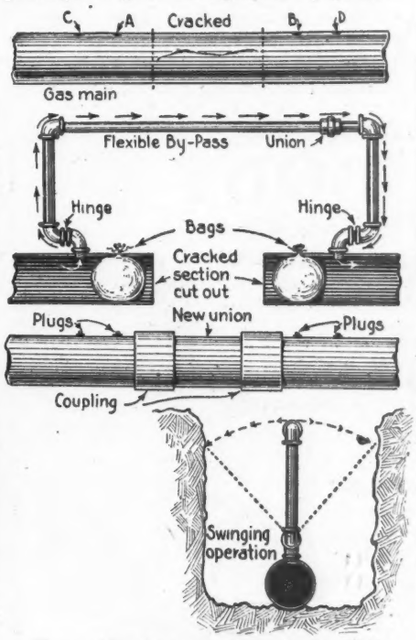
Stopping the leak with sealing-wax or gum

Replacing Section of Gas-Main While the Gas Is Turned On

A VERY interesting process by which a cracked section of a gas-main was repaired without having the gas shut off is shown in the illustration.

By means of this arrangement the gas is conducted by or past the section being worked on. It was also flexible so that it could be swung to one side or the other as the work required.

Holes were drilled at *A*, *B*, *C*, and *D*, and tapped for plugs, and rubber gas bags inserted in the holes *A* and *B*, and inflated to shut the gas off from the broken section. The flexible by-pass was fitted on and connected with unions. The arrows show the passage of gas through the by-pass.



Two rubber bags, one in each pipe-end, were used to shut off the gas in the mains

After a new section was fitted in place with couplings and a piece of pipe, the couplings having right and left threads, the bags were removed, and the by-pass and plugs were turned into the holes.—JAMES M. KANE.

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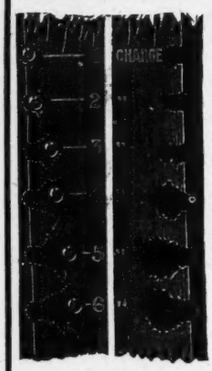

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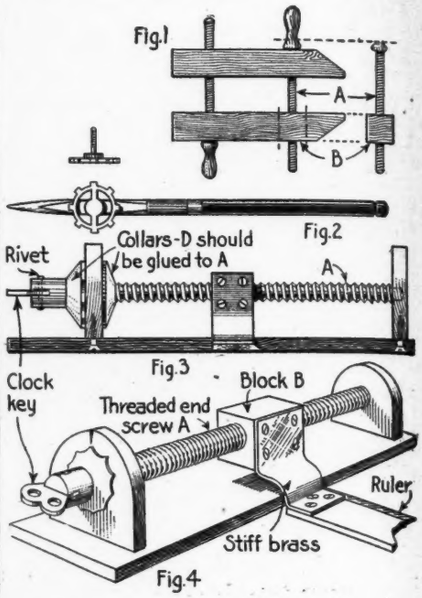
How to Make a Section Liner from a Carpenter's Clamp

NEEDING a section liner for a number of jobs, a draftsman, who did not feel able to purchase one, made the one here illustrated for his own use.

The base and supports were made from an old packing-case. The screw *A* and block *B*, Fig. 1, were taken from a carpenter's clamp.

The collars *D*, Fig. 3, are heads made from an empty cotton spool,



The wood screw of a carpenter's clamp furnished the spacing device for this section liner

one of which is notched and the other one glued to the screw *A*. An old clock key inserted in a slot cut in the end of the screw *A* provides a means of turning it.

The screw *A*, when in position between the supports, should fit snugly and allow no end play. When the key is turned to the right, the screw *A*, with the collars fastened to it, revolves in its supports and draws the block *B* toward the key end. The distance the block is drawn depends on how far the key is turned each time, which may be easily gaged by the notches in the collar.

To do graduated shading, a gear wheel from an old alarm clock, with part of the teeth filed off, should be soldered to the gage screw of the ruling pen, as shown in Fig. 2. By turning this wheel in either direction one notch at a time, the pen is opened or closed an equal distance, thus giving lines of different widths.

The section liner complete, as shown in Fig. 4, is, of course, used, but the spacing is not changed as with the pen.

With this section liner a draftsman can do as good work as with the most expensive tool on the market. It may be a little slow to work, yet it is accurate if the adjustments are set true to the markings, and if the screw threads fit the nut snugly.—ALBERT E. JONES.

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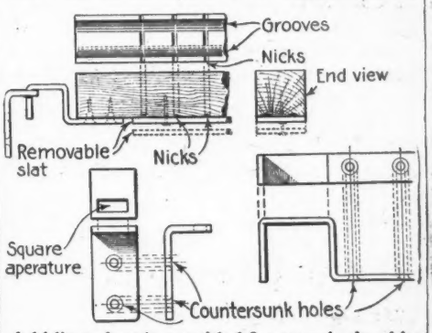


A hiding-place is provided for vermin in this poultry roost to catch them during the day

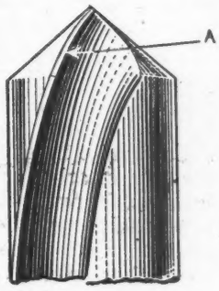
hot water to destroy them. The roost shown provides a place on the underside where they may hide. It consists of a lath held under the roost with small nails to make the hiding-place inviting for them. You simply lift the roost from the holders, slightly loosen the pieces of lath, and pour boiling water between the lath and the roosts. This will kill all vermin and destroy any eggs that may be there. The roosts will quickly dry if the water is hot.

In this way a poultry house can be completely cleared of all blood-suckers on the place. The iron ends are colder than the wood, and the vermin will not crawl over them.

Mites do not attack fowl in the daytime, and it is difficult to discover their presence. Body-lice remain on the fowl all the time, and they may be exterminated in the following way: Hang the fowl head downward in a barrel, and rub a small amount of fluoride of soda well into the feathers for half the length of the fowl. This is a harmless powder and it can be used on chicks as well.—GEORGE W. SMITH.

Easing the Action of a Drill in Soft Metal

THE amateur mechanic is often troubled when drilling in soft metals, such as copper, brass and lead, by having the drills twist or break off in the chuck. This can be overcome to a great extent by grinding the cutting edges of the drill in the manner indicated in the illustration.



A slight flat surface prevents sticking

Probably the best method of grinding is to have the plane of the new face *A* about parallel with the axis of the drill. Make the face quite small—about 1/32 in. is big enough.—L. B. ROBBINS.

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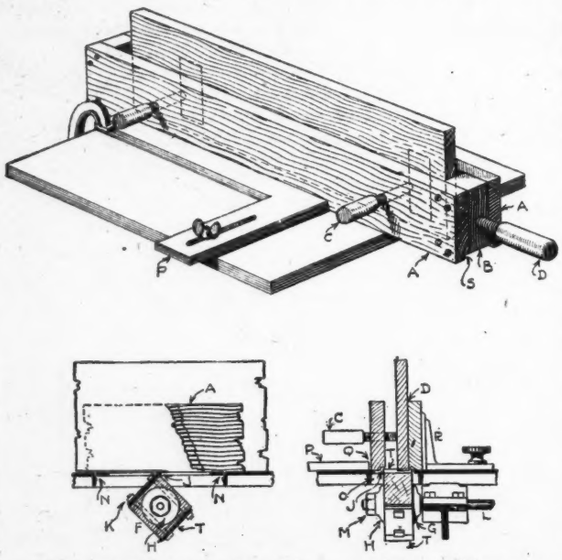
A Jointing Jig for a Circular Saw Table

WITH the jig illustrated a circular saw table and machine may be made into a combination saw and jointer. This device is especially valuable in jointing short pieces of board for gluing, as the edges of each piece can be made straight and square, ready for the glue at one cut.

The jig may be made of 1¼- by 6-in. kiln-dried stock for the sides *A*. The separators *B* are made of hard wood



The jig will hold a board in an upright position so that its edge may be planed squarely on a jointer

2 in. square, and the sides are fastened to them with screws. This will permit one or more boards, which aggregate less than 2 in. in thickness, to be jointed at once. The screws *C* are to hold the board firmly in the jig; therefore the sides in which they are fitted must be of hard wood to hold the threads. The screw *D* prevents end motion. If a narrow piece of sandpaper is glued upon the inside of the jig directly opposite each of the screws *C*, it will reduce vibration and prevent the board from slipping. The bottom of the jig must be jointed perfectly straight and square with the sides so that it will rest upon the table without tipping.

The jointing head is a piece of hard wood *F* about 2½ in. thick and large enough to clear the collars *G* and *H* and allow the cutters *T* to project above the table at *J*. The cutters are held in place with bolts at *K*. The wood, bolts, and cutters must be carefully balanced.

It is quite necessary to have a long mandrel or arbor to allow the jointing head to fit against the collar *H* and nut *M*, although the collar *H* may be omitted if the hole in the wood fits the arbor closely. The saw table should have a movable throat which fits in at *N* to permit the jointing head to be used.

Place the guide *D* loosely against the side of the jig, as at *Q*, to prevent the jig from swinging against the side of the cutters. The regular splitting gage *R* guides the jig as the board is fed through the machine. The groove *S* in the bottom of the jig is to allow the cutters to clear and leave enough wood on the lower edges of the sides to rest firmly on the table.—CHARLES A. KING.

The Use and Construction of Volta's Electrophorus

THE electrophorus is an instrument devised by Alexander Volta in 1775 to obtain a series of electric charges of electrostatic induction from a single charge. It consists essentially of a non-conducting plate which can be easily excited by friction, and a metal disk of smaller diameter than the plate, provided with an insulating handle. The plate is most conveniently made of ebonite, although such plates were originally made by melting together resin and shellac and pouring the mixtures into a shallow tin.

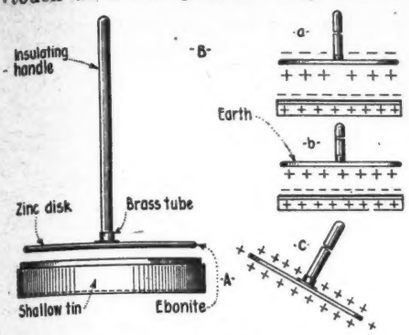
The ebonite plate *A* should be circular in shape to fit tightly into a cheap shallow tin. It should be cemented to the tin with a little gutta-percha or an elastic glue, the application being of light pressure and projecting slightly over the top of the tin. For very good results the ebonite need not be over ¼ inch thick. It is absolutely essential, in order to obtain the maximum efficiency of the machine, to have all edges perfectly round without any sharp angles.

If these requirements appear to be too rigid for the builder, the metal tin—or "sole," as it is called—may be left entirely out of the construction. A sheet of zinc is next required. This should not be more than 1/20 inch nor less than 1/25 inch in thickness. If this cannot be purchased in circular form, it must be cut from sheet stock. The outer edge of the zinc should be rounded or turned up by careful hammering.

The diameter of the ebonite circle should be not less than 8 inches, and the zinc disk about ½ inch less. A short piece of brass or zinc tubing is soldered in the center of the smaller disk for the insertion of the insulating handle. This tube should not be larger than 5/16 inch in diameter. Instruments bought in shops usually have glass handles, but these are not so good as the ebonite. The finished product should appear as shown at *B* in the illustration.

To use the electrophorus, warm plate *A* slightly until it is free from moisture. Then charge it negatively by friction. This is done by rubbing it or striking it with warm flannel or fur. The metal base then has a bound positive charge, which helps to hold the negative charges on the ebonite *A*.

By means of the insulating handle place the zinc disk on the plate. Owing to slight irregularities on the surface of the two plates, they will touch at a few points. There is in-



An electrophorus for making a series of charges of electrostatic induction from a single charge

duced in *B* a free negative charge and a bound positive charge, as is illustrated in *A*.

The metal disk *B* is then touched with the finger, which is equivalent to connecting it to the earth, and the negative charge on the upper surface disappears. Remove the finger and raise the disk by the insulated handle. By this process the positive charge is made a free charge and can be transferred to an insulated sphere.

This procedure can be repeated, the plate *B* being charged each time without decreasing the charge on the ebonite plate, the energy represented by the induced charges being obtained at the expense of the operator who draws out the lines of force connecting both the positive and negative charges.—HERMAN NEUHAUS.

A Discarded Water-Heater Used for a Plant-Box

A NEW use was found for a discarded water-heater by cutting out one side and filling it with earth for holding plants. Such a plant-box

An old range boiler painted to resemble a birch log and used for a plant-box

may be painted to suit the owner, and it may be made very effective if tinted to resemble a white birch log. By copying a birch log or tree from which the white bark has been peeled in places, allowing the brownish second layer to show through, the painting may be made very effective. Paint the boiler two coats of cream color, and then streak it with lines and patches of reddish brown, taking care not to make these patches too even or too regular.—W. H. SARGENT.

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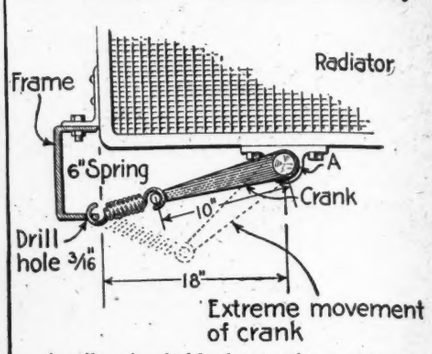
A Home-Made Automobile Crank-Holder

STARTING cranks fastened to an automobile cause much trouble and annoyance by swinging, rattling, and wearing the bearing unnecessarily.

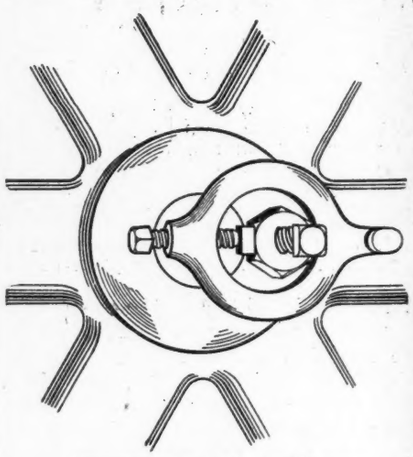


A coil spring holds the starting crank of an automobile to keep it from rattling

By the use of an ordinary hook-end spiral spring of proper length to give a medium tension on the crank, these faults may be eliminated. To make this, drill a 3/16-in. hole in the frame, or fasten to a convenient bolt a 4- to 6-in. coiled spring, which may be purchased cheaply at any hardware store, with ends bent out to fit the bolt and crank. This holds the crank rigid and prevents noise and wear. A few drops of oil placed at *A* will keep it lubricated.

A Lathe Dog Used to Pull Out a Tightly Fitting Key

TO remove a tightly fitting key, a lathe dog, a hexagon nut, and a set-screw—all easy to obtain—will do the work. Clamp the hexagon nut with the lathe dog, and turn up the screw tightly against the projecting end of the key. In turning the set-screw through the nut the end will make a bearing on the face of the hub of the wheel. Continuing to turn the



Arrangement of the lathe dog, set-screw, and nut for pulling a tightly fitting key in a shaft

set-screw will raise the nut and lathe dog away from the hub, drawing the key with them.—E. S. GOODELL.

A Riveting Stake for Use in the Bench Vise

THERE is often need for a riveting stake in a small shop for various kinds of riveting. The usual thing the workman does is to put any old piece of bar stock in the bench vise, and proceed to squeeze it up as tight as possible to keep the iron from moving when striking the riveting blows.

Often the vise screw is damaged or the vise broken by this overstrain: just as often the badly chosen piece of stock slips from the grip of the vise, causing delay and sometimes injury to the workman.

The sort of stake shown in the illustration has been found the handiest tool for this work. It is easy to make, for it is simply a piece of suitable round

Just how the pins should be driven into the stock to enable the vise to get a lasting grip

stock with one end bent at right angles, and a couple of pins put in it in order to prevent its moving in the vise. This simple expedient costs little to make, but its use will speed up the riveting and make it a pleasanter job for the riveter.—CHARLES H. WILLEY.

Turning Gloves Doubles and Trebles the Wear

IN work where cloth gloves are necessary to protect the hands from rough surfaces, etc., it will be found that one glove often wears out first — generally the left one. To give a larger percentage of wear, when the left glove is almost worn through, turn the gloves inside out. The former right glove will fit the left hand, and vice-versa.

The gloves can now be worn till the left one is again almost through. Then, by slashing the palm in each glove, they can be reversed so that the back of the glove comes on the palm of the hand.

In practice I have found this to give between two and three times the ordinary wear of gloves; and when a workman uses three pairs a week—as many did in one place where I worked—it amounted to a saving of many dollars a year.—NEAL BROWN.

New Stomachs for Old in 48 Hours

By R. S. Thompson

THOUSANDS of people who suffered for years with all sorts of stomach trouble are walking around today with entirely re-made stomachs—stomachs which have been re-made in from 48 to 72 hours. They enjoy their meals and never have a thought of indigestion, constipation or any of the serious illnesses with which they formerly suffered and which are directly traceable to the stomach.

And these surprising results have been produced not by drugs or medicines of any kind, not by foregoing substantial foods, not by eating specially prepared or patented foods of any kind, but by eating the plainest, simplest foods *correctly combined!*

These facts were forcibly brought to my mind by Eugene Christian, the eminent Food Scientist, who is said to have successfully treated over 23,000 people with foods alone!

As Christian says, man is what he *eats*. What we take into our stomachs today, we are tomorrow. Food is the source of all power, yet not one person in a hundred knows the chemistry of foods as related to the chemistry of the body. The result is we are a nation of "stomach sufferers."

Christian has proved that to eat good, simple, nourishing food is not necessarily to eat correctly. In the first place, many of the foods which we have come to regard as good are in reality about the worst things we can eat, while others that we regard as harmful have the most food value.

But perhaps the greatest harm which comes from eating blindly is the fact that very often two perfectly good foods when eaten at the same meal form a chemical reaction in the stomach and literally explode, liberating dangerous toxic poisons which are absorbed by the blood and circulate throughout the system, forming the root of all or nearly all sickness, the first indications of which are acidity, fermentation, gas, constipation and many other sympathetic ills leading to most serious consequences.

And yet just as wrong food selections and combinations will destroy our health and efficiency, so will the right foods quickly create and maintain bodily vigor and mental energy. In my talk with Eugene Christian, he told me of some of his experiences in the treatment of disease through food—just a few instances out of more than 23,000 cases he has on record.

One case which interested me greatly was that of a young business man whose efficiency had been practically wrecked through stomach acidity, fermentation and constipation, resulting in physicial sluggishness which was naturally reflected in his ability to use his mind. He was twenty pounds underweight when he first went to see Christian and was so nervous he couldn't sleep. Stomach and intestinal gases were so severe that they caused irregular heart action and often fits of great mental depression. As Christian describes it, he was not 50 per cent. efficient either mentally or physically. Yet in 24 hours, by following Christian's suggestions as to food, his constipation was relieved, although he had formerly been in the habit of taking large daily doses of a strong cathartic. In five weeks every abnormal symptom had disappeared—his weight having increased 6 lbs. In addition to this, he acquired a store of physical and mental energy so great in comparison with his former self as to almost belie the fact that it was the same man.

Another instance of what proper food combinations can do almost overnight was that of a man one hundred pounds overweight whose only other discomfort was rheumatism. This man's greatest pleasure in life was eating. Though convinced of the necessity, he hesitated for months to go under treatment, believing he would be deprived of the pleasures of the table. He finally, however, decided to try it out. Not only did he begin losing weight within a few hours, regaining his normal figure in a matter of weeks, but all signs of rheumatism disappearing, and he found the new diet far more delicious to the taste and afforded a much keener quality of enjoyment than his old method of eating, and wrote Christian a letter to that effect.

But perhaps the most interesting case that Christian told me of was that of a multi-millionaire—a man 70 years old, who had been traveling with his doctor for several years in a search for health. He was extremely emaciated, had chronic constipation, lumbago, and rheumatism. For over twenty years he had suffered with stomach and intestinal troubles which in reality was superaciduous secretions in the stomach. The first menus given him were designed to remove the causes of acidity, which was accomplished almost overnight. And after this was done he seemed to undergo a complete rejuvenation. His eyesight, hearing, taste, and all of his mental faculties became keener and more alert. He had had no organic trouble—but he was starving to death from malnutrition and decomposition—all caused by the wrong selection and combination of foods. Almost immediately after following Christian's advice this man could see results, and after six months he was as well and strong as he had ever been in his life.

These instances of the efficacy of right eating I have simply chosen at random from perhaps a dozen Eugene Christian told me of, every one of which was fully as interesting, and they applied to as many different ailments. Surely this man Christian is doing a great work.

I know of several instances where rich men and women have been so pleased with what he has done for them that they have sent him a check for $500 or $1,000 in addition to the amount of the bill when paying him.

There have been so many inquiries from all parts of the United States from people seeking the benefit of Eugene Christian's advice and whose cases he is unable to handle personally that he has written a little course of lessons which tells you exactly what to eat for health, strength and efficiency. This course is published by The Corrective Eating Society of New York.

These lessons, there are 24 of them, contain actual menus for breakfast, luncheon, and dinner, covering every condition of health and sickness from infancy to old age and for all occupations, climates, and seasons.

Reasons are given for every recommendation based upon actual results secured in the author's many years of practice although technical terms have been avoided. Every point is explained so clearly that there can be no possible misunderstanding.

With these lessons at hand it is just as though you were in personal contact with the great food specialist, because every possible point is so thoroughly covered that you can scarcely think of a question which isn't answered. You can start eating the very things that will produce the increased physical and mental energy you are seeking the day you receive the lessons, and you will find that you secure results with the first meal. This, of course, does not mean that complicated illnesses can be removed at one meal, but it does mean that real results can nearly always be seen in 48 hours or less.

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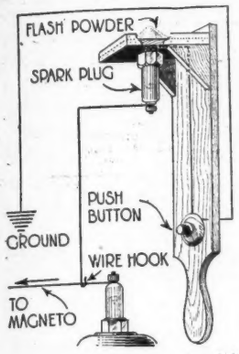
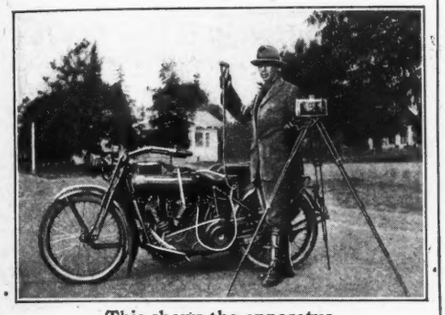


Diagram of flash pistol


This shows the apparatus set up ready for use

The lamp-cord is double-stranded. One wire connects the body of the pistol with the ground or body of the machine. The other wire connects the spark-plug of the powder-pan with the terminal wire from the magneto of the vehicle. The trigger on the handle of the pistol operates the switch that closes the circuit for sending the ignition spark into the powder. The instant the trigger is pulled, *bang!* goes the powder. A premature explosion is impossible, for the pistol cannot be fired until the circuit is closed.—JOHN EDWIN HOGG.

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Where Am I?

The Aviator Asks and Radio Answers

By Theodore E. Hedlund

IN the last moments of hostilities abroad, British and American airmen perfected a radio direction-finding apparatus which promises a new era in long-distance flights. By its use aerial navigators can determine their exact position in the heavens, night or day, and regardless of weather.

The pilot and crew might be hopelessly lost and hundreds of miles off their course; yet this simple apparatus would solve their difficulties in a few minutes' time. It was intended for long-range night bombing raids in Germany, but the ending of hostilities prevented its use in that direction. Now the instruments will be employed for commercial and scientific travel in the skies.

The Proposed Transatlantic Flight

New impetus should come to the proposed transatlantic flight from the United States to Europe as a result of this discovery. The benefits of the radio achievement will also be reaped by those who are planning exploration trips over the north polar regions. Perhaps our aerial mail service will also improve with regard to distant mail routes, which have never proved successful.

Many night bombing ships had been sacrificed during the war as a result of bad weather and fog when pilots were unable to see landmarks and their maps became worthless. The helpless crews floundered along in the night air, and eventually had to make forced landings either on hostile territory or in neutral countries, where they were interned.

To overcome such predicaments, wireless experts and navigation officers began a study which is now completed and does away with the visual method of navigation. Instead of taking bearings by known landmarks, the bearings are determined from known wireless stations by means of radio, and by this system the pilot can ignore both stars and ground and steer a true course at all times and in all sorts of weather.

Two coils of wire at right angles to each other are placed in the fuselage of the ship to pick up wireless calls from any land station. The larger the coils the more energy they pick up, and they are only limited in size to the dimensions of the fuselage. Calls can be received from thousands of miles away without any traveling aerial or antenna wires. All that is needed, in addition to the coils, are the usual wireless instruments, an amplifier and tuning box.

This scheme of direction-finding

is best described by work done in experimentation. A plane left the ground at night, and its pilot and navigation officer paid no heed to direction, time, or compass. After an hour in the air, neither knew his whereabouts or general location. The navigation officer then tuned in his instruments and picked up wireless calls from the powerful station at Berlin. Usually Berlin was sending out press matter to smaller stations throughout Germany at night.

Determining the Compass Direction

By swinging the two coils described, the wireless wave from that station either decreased or intensified in energy. This is known as "tuning in."

When the coils were adjusted to the point of greatest efficiency for receiving, the navigation officer read a compass attached to the apparatus, and determined the exact compass direction from which the call was heard. Making correction for the known curvature of that wireless wave, he drew a line on his map from Berlin at the angle given by the compass.

This placed the position of the aircraft as somewhere on that line. Taking bearings in the same manner by tuning in with wireless calls from the Eiffel Tower, Paris, and with London, the navigator soon determined his position on that line by an old system of triangulation. Special charts were used in place of groundmaps, and at no time was it necessary for either the pilot or the navigation officer to see landmarks or study the stars.

A Year's Work on the Idea

The first idea that radio could be used in directing aircraft was conceived about a year ago. Since that time Americans have worked both with and independent of the British on this subject. The use of direction-finding by wireless in planes was on the point of being perfected when the armistice was signed, and missed its mission as far as night bombing raids were concerned.

But transatlantic flying and north polar exploration trips will be much simplified by using this system of navigation. An American officer who should be given credit for much accomplished on this important apparatus is Lieutenant Herbert Bassett, of Paw Paw, Michigan, an aerial radio officer who worked on the discovery together with the Royal Flying Corps and the British Navy. He was stationed at the field headquarters of the American night bombardment section in Sussex, England.

While these tests were in progress, other experiments were being conducted in wireless telephony, making possible communication between planes in the air. These discoveries have been perfected to a point where there

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A map becomes worthless for visual navigation when mist, fog, or rain hides known landmarks; and the terse reports of night bombing operations during the war, announcing the number of ships that failed to return to the aerodromes after certain long-distance raids, testified to the need of a more accurate means of navigation.

The progress made in wireless development has dispelled the remoteness of the North Pole and brought closer America and Europe, and students of aerial navigation are now convinced that the fear of becoming lost has been eliminated from the minds of those who propose to explore and venture by means of aircraft.

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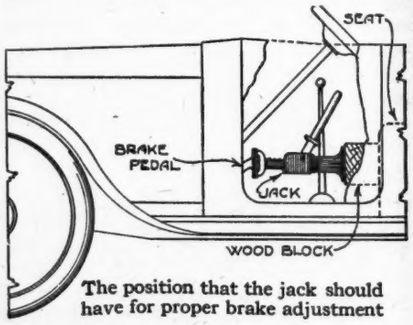
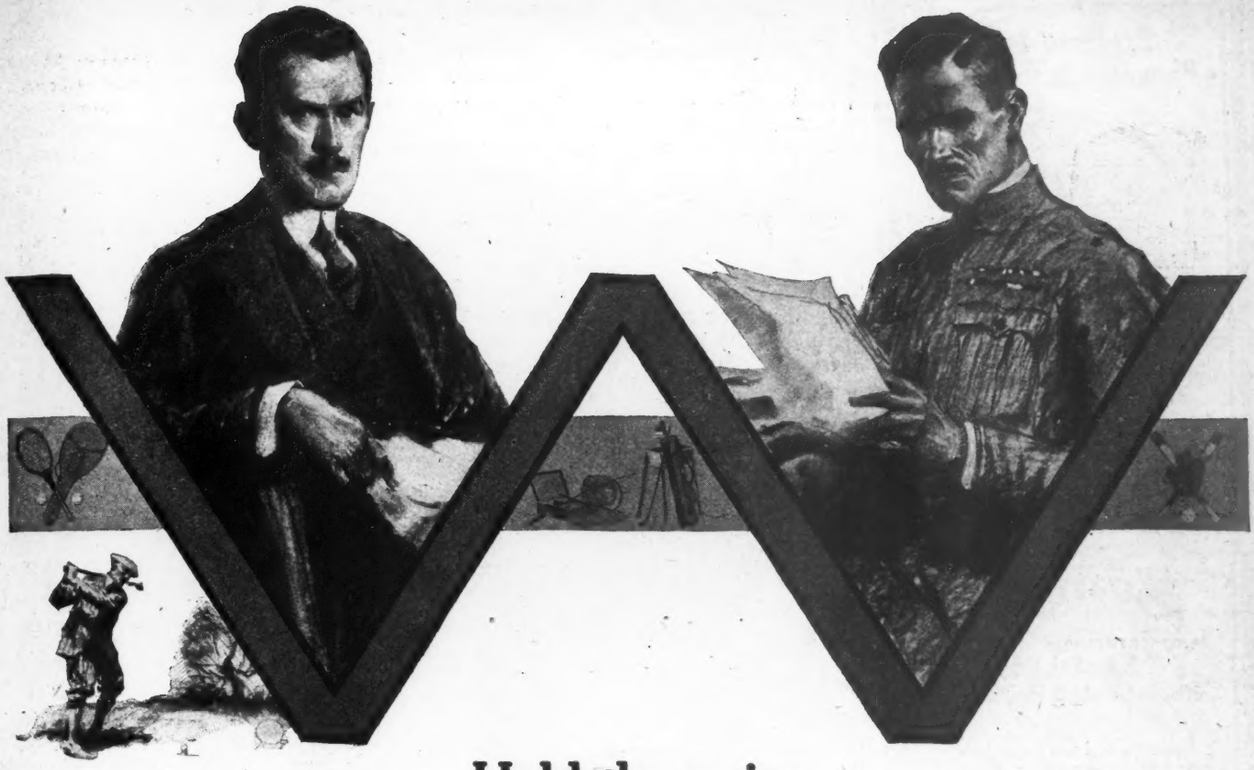
TO adjust automobile foot-brakes single-handed, jack up the rear wheels, one side at a time, while setting the band on each wheel; then, with a block against the seat panel and a jack placed in as shown to force the pedal down, turn the wheel and the screws on the brake-band, adjusting it to the proper tension. Make both brake tensions equal. Take up easily



The position that the jack should have for proper brake adjustment

one brake-band at a time. By turning the wheel over with the hands the proper brake adjustments are easily made.

Count the number of clicks in the jack as it is operated for each wheel, and compare them. The wheel requiring the most clicks on the jack until the wheel cannot be turned by hand must have its brake-bands tightened to equalize them—P. P. AVERY.



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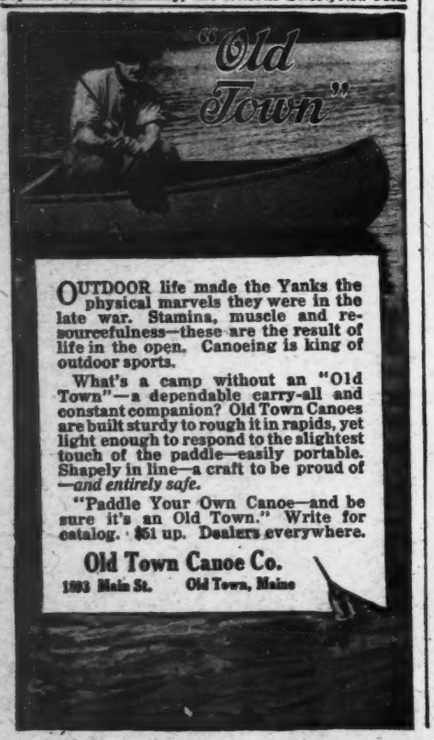

OUTDOOR life made the Yanks the physical marvels they were in the late war. Stamina, muscle and resourcefulness—these are the result of life in the open. Canoeing is king of outdoor sports.

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Transplanting-Boxes of Paper for Early Hothouse Sprouting

PAPER seed-pots are handy, cheap, and easy to make. If seedlings are raised in fire-baked porous flower-pots, the roots are invariably disturbed when they are taken to the garden and placed in their respective beds. All this is avoided with paper pots, which are merely sunk into the ground.

These pots are especially recommended for plants that are retarded by transplanting, such as cucumbers, melons, peppers, etc. This is of still greater advantage with cucumbers, beans, and other plants if they are placed in the ground at the time other people are sowing their seeds for these

A handy transplanting paper box to safeguard the roots of early sprouts

plants. Then an earlier harvest will be assured.

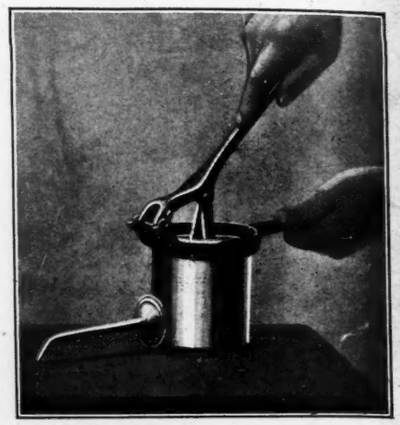
Round paper pots can be purchased, but these are not as desirable as the square pots, since the former are difficult to handle, while the latter can be easily packed.—DR. E. BADE.

What to Do With Dirty Crank-Case Oil

OLD worn-out, grit-filled oil, drawn from automobile crank-cases, clutches, drip-pans, and other sources, need not be thrown away. It may be mixed with coal dust and screenings and used for fuel. A pint or more used with each hod of screenings, mixing well so as to make a dry, pasty mass, will barely cling together. In this way two otherwise useless products may be used as fuel.—RONALD PRINDLE.

Making a Grease-Gun from a Potato-Masher

THE accompanying picture shows a home-made grease-gun which has proved exceptionally satisfactory and efficient in handling grease of any compound.

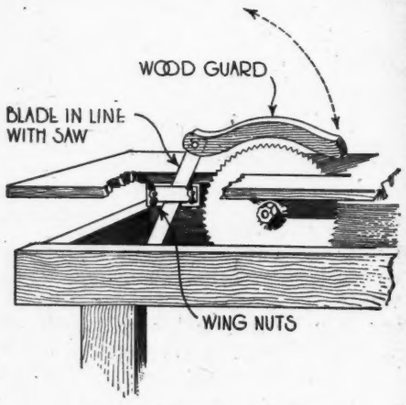


This device provides an economical means of injecting grease, besides preventing grease from getting on clothing as often happens when the hand method is used

In making this apparatus a potato masher of the ordinary type was used, the perforated bottom being covered with a sheet of tin. The spout of a discarded oil-can was soldered into a hole previously cut in the wall of the masher near the bottom. You press down on the handle and the circular piece of metal which is attached to it presses down on the grease and forces the grease to come out of the spout.—ERNEST SCHWARTZ.

An Adjustable Safety Guard for the Circular Saw

WHEN a new circular saw was placed in a certain shop, the person taking charge of it immediately planned the safety guard shown in our illustration. It was made of a flat piece of steel a trifle thinner than



Illustrating how the safety guard should be attached

the blade of the saw, with an arc of a circle cut from hard wood for the guard.

It was attached with a clamp and bolts which were of the wing-nut type.—THEODORE J. BECKER

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How to Carry a Spare Wheel on a Bicycle

A SPARE wheel on a bicycle is often very useful when taking a cross-country ride. The wheel should be a rear one with the sprocket, since this can be used for either wheel. Make

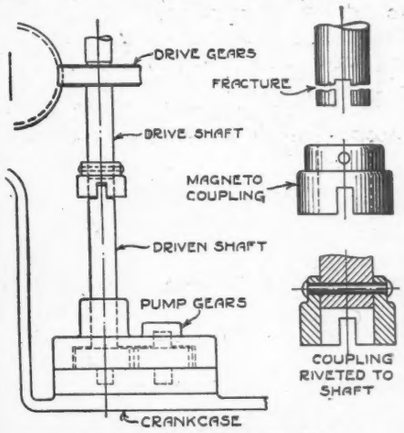
All ready for a punctured tire

a bracket of strap-iron, and attach three leather straps to hold the wheel in place. The best place to carry this third wheel is above the rear one. There it does not interfere with the rider.—H. W. HAHN.

Repairing a Broken Oil-Pump Shaft

THE oil-pump shaft on an automobile engine broke at the point indicated in the illustration. The break was caused by the fact that the two projections of the shaft that engaged with the lower shaft were too small to stand the strain that was placed upon them.

To replace the broken shaft with a new one would be expensive, since the shaft and drive gear were made of one piece of steel. The repair was



The repaired oil-pump shaft

made by using an old magneto coupling that was in good condition. One-half of this coupling having a slot exactly the same width as that of the broken pump shaft, a duplicate part was easy to attach.

As the hole in the coupling was too small, it was placed in a lathe chuck and bored out to the proper size. The flange was then pressed on the shaft, and both were riveted together with the aid of a ¼-in. pin.—ADOLPH KLEIN.

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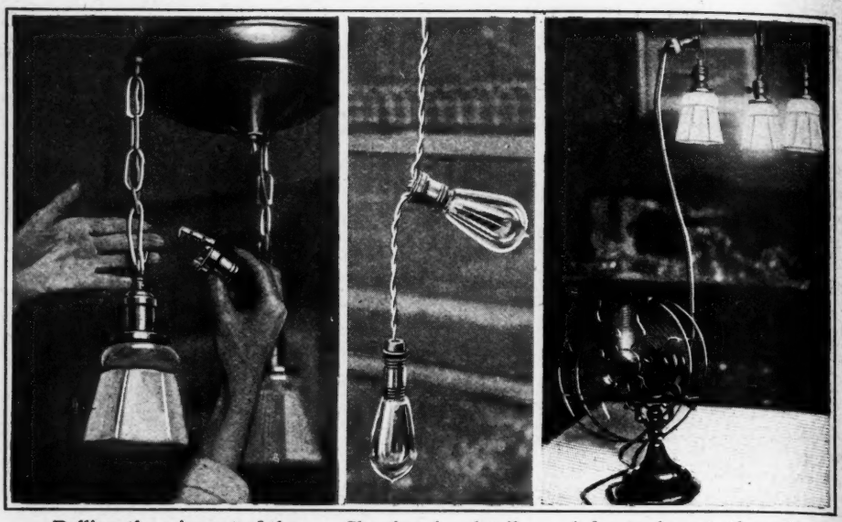
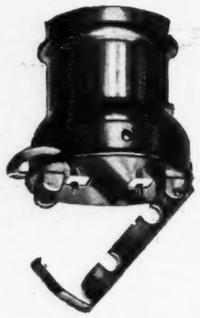


Pulling the wire out of the chain in the hanger and attaching the socket to it

Showing in detail the socket attachment on the wires

A fan cord run to the socket attachment, where it is clamped to a drop cord

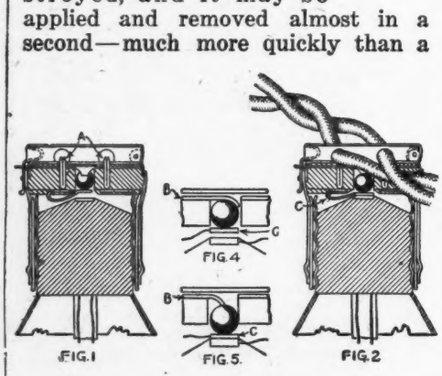
ATTACHMENT plugs of various kinds have been on the market for years, but these must be used in the regular socket wherever it is placed. The one illustrated differs from the ordinary kind, for it can be attached to any drop cord or rubber-insulated wire at any point, and when removed no trace of the attachment can be found. The advantage of this device is that the lighting arrangement is not destroyed, and it may be applied and removed almost in a second—much more quickly than a globe can be taken out and a plug screwed in.



The attachment complete for clamping to the wires

A cross-section of the attachment is shown in Fig. 1, with the base of the lamp in place. The connection pins are shown at *A*. These pins pierce the insulation of the wire and make the contact. In Fig. 2 the device is shown attached to the wires, and in Fig. 3 the switch.

In Fig. 3, 4, and 5, *B* represents a spring finger that forces the small glass ball down as the switch is moved from left to right, which in turn forces the spring *C* into contact with the lamp or plug, thus completing the circuit. When the switch is moved over to turn on the current, the narrow slot *D* is brought into close contact with the spring snap *E*, Fig. 6, thus making it impossible to remove the socket from the wires while the current is on. Therefore no arc is formed to burn the insulation on the needle-points. In Fig. 7 and 8 is shown the method of piercing the insulation of the wires.



Cross-section of the parts, showing the glass ball which works the switch when the socket is clamped to the wires

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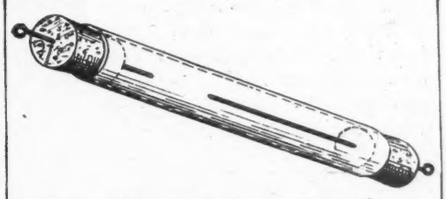
Regulating the Current from an Induction Coil

WHEN using the induction coil, instead of the sliding tube arrangement, it is often convenient to have a separate regulator to vary the strength of shocks, etc. The instrument illustrated will accomplish this result. Its construction is simple, and the materials required are readily procurable.



Corks with wires are inserted in the ends of the tube after it is filled with water

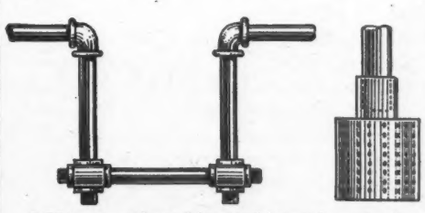
A glass tube about 12 in. long and having a bore of 1 in. is fitted with two sound rubber corks at either end. A short length of No. 16 gage copper wire is run through the center of one of the corks, a long length (about 11 in.) is run through the other, and a ring made at each extremity. After inserting one of the corks, fill the tube with water, and insert the other cork.

Wipe the glass and corks dry and make the joints impervious to water with sealing-wax. The greater the distance between the wires in the circuit, the weaker will be the shock from the coil.—HERMAN NEUHAUS.

Making a Strainer for a Brine-Pipe Line

IN refrigerating plants where seals of the U-type for pans are used, floating debris often enters and prevents the flow. Usually strainers are placed in the intake to prevent this, but it sometimes does not stop the entry of dirt, and unless some means is provided there is no way of removing this sediment.

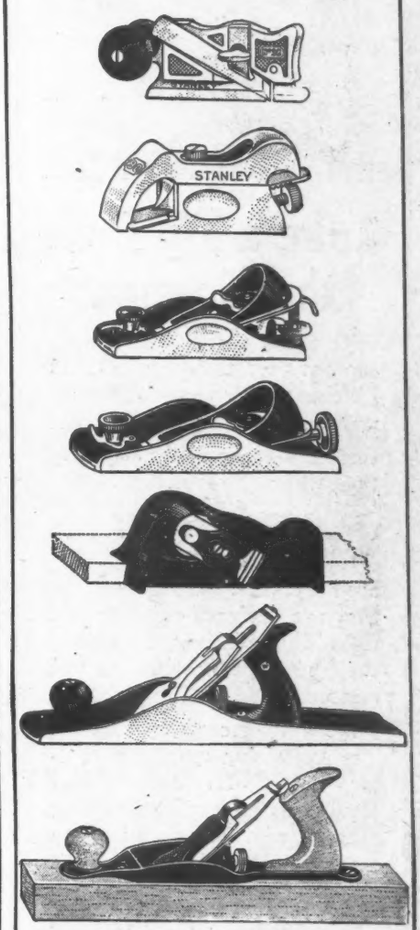
The illustration below shows how a strainer, or strainers, may be affixed to the bend, made of pipe and fittings, so that the strainer part may be removed and the sediment taken out.



A U-type seal used in a refrigerating plant, and the strainer to keep out the sediment

The strainer part is made from perforated metal of medium gage. The holes should not be larger than 1/16 in. Enough holes should be provided so that the flow of the liquid will not be retarded by the presence of the strainer.

Stanley Tools



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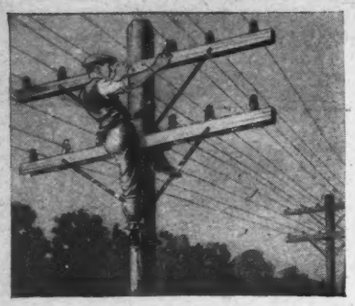

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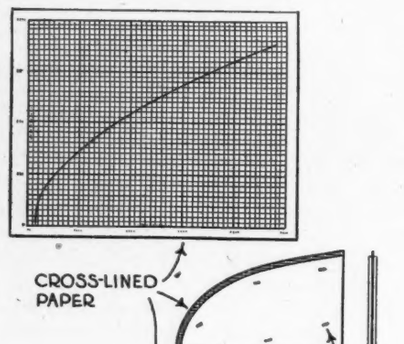
How to Draw Smooth Curves Accurately Placed

TO draw smooth, accurately placed curves on cross-lined paper, follow the method herein described: First plot the curves on a sheet of cross-lined paper, or if it is thin paper prick the plotted points through very lightly on smooth, firm cardboard. Plot a number of points, especially where the curvature is greatest. If the curve is to be used for reading values, do the plotting with the aid of a small reading-glass. The points should be so close together that lines ruled with a straight edge nearly trace the curve when the points are joined.



Several curves of the same kind may be easily drawn by this method

Having plotted the points, sketch in the curve in pencil, rubbing out and tracing until it is apparently smooth. Then make the best line slightly heavier with a three-H pencil, and carefully erase all the rest. If the curve is on heavy cross-lined paper, cut near the curve with a pair of shears; if it is on the card, use a knife. Be careful not to touch the line, but get as close to it as possible.

Next, mount a piece of fine sandpaper on a piece of smooth squared stick, and gently go over the curve, wearing it down to the pencil line; or if, on examination, this line is slightly out, allow for the error. To be sure the edge is smooth, hold it up and sight along it. Since the finished curve is to be very accurate and smooth, time must be spent in sandpapering.

Now, when finished, lay the paper or cardboard curve on the sheet of cross-lined paper you intend to put the finished curve on, getting it exactly in position, and testing by reference to its values at many points. When satisfied that it is correct and that it is correctly placed, draw the curve with one sweep of a three-H pencil along the edge of the cut-out, making sure first that there is a sharp point on the pencil.

Now, if the cut-out curve is of paper, cut two pieces of thin cardboard almost the shape of the curve, and place them one above and the other below the curve, sandwich fashion, allowing the paper edge to project about 1/16 in. Fasten all three pieces together with paper-fasteners. If the cut-out is on cardboard, fasten a piece of cardboard below it, a trifle in from the edge.

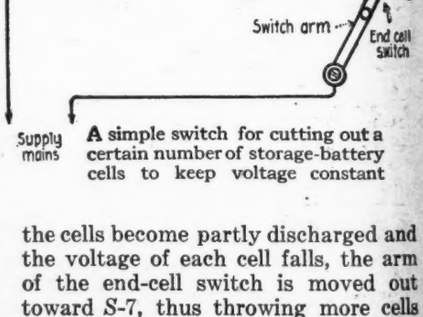
In either case, the mounted curve can be used to trace the curve in ink, for it is raised from the surface of the lower card. Lay the cut-out in place over the pencil line, try it over several times with the dry pen to see how it works, then fill the pen and draw it along the line lightly, just pressing it enough to keep it in contact with the cut-out edge, and do not remove it until the line is completed.—ERNEST A. HODGSON.

End-Cell Control on Constant Potential Lines

IN rural districts storage batteries are generally used to supply power to the lighting circuits. Since the voltage of a battery of storage cells will fall off as the cells become discharged, some method must be employed whereby the voltage across the line may be kept constant.

A very good and economical method is to cut in and out a certain number of cells at the end of the series, as more or less voltage is required by the lamp load.

In the accompanying sketch, *S*, with all its digits, is called the end cells. As



A simple switch for cutting out a certain number of storage-battery cells to keep voltage constant

the cells become partly discharged and the voltage of each cell falls, the arm of the end-cell switch is moved out toward *S*-7, thus throwing more cells across the supply line and raising the voltage.

In recharging a battery where the end-cell control method is employed, all the cells are at first thrown in circuit. Since the end cells are less discharged than the others, they will require only a little charging. As soon as one of the end cells becomes fully charged, it is cut out of the circuit by moving the switch-arm back toward *S*-1.—PETER J. M. CLUTE.

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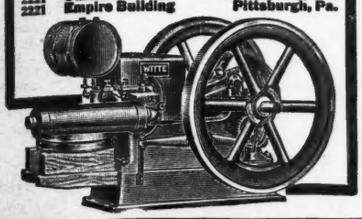

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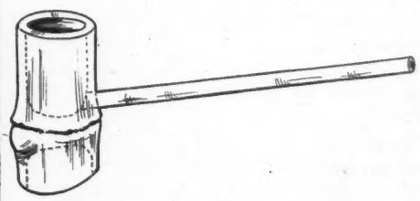
A Pipe Made from a Joint of Bamboo

ON a week-end trip to a camp in the woods, I found that I had left my pipe at home, and I missed it greatly. The camp was so located that it was impossible to purchase one, and I therefore decided to make one.

After searching the camp I wandered down to the boat-house, and there caught sight of an old bamboo fishing-pole stuck in the rafters of the roof. On examining it, I found that a piece cut from the butt would make the bowl and a piece from the opposite end would make the stem. By cutting the butt near one of the natural sections that form when the bamboo is



A rough and ready pipe may easily be made from the joint of a bamboo fishing-pole and its tip

grown, I made the bottom of the bowl. All that remained for me to do was to make a hole and assemble the stem with the bowl. I then had a pipe.—W. E. BARNES.

Temporary Repairs on a Leaking Boiler

A TEMPORARY repair on a leaking boiler can be made by cutting out the leaking part. Often this is the only way to avoid a long delay and a shut-down. Though the fuel expense is increased a bit, the saving until repairs can be properly made or new equipment received fully justifies the expedient. In the case of a sectional boiler used for heating, it may be found that a section has sprung a leak through a sand hole right over the grates. No kind of plug will keep the water off the fire, but by cutting out the mud drum and steam connections and screwing in plugs, the other part of the boiler may be operated as before.

With a leaky tube in a boiler that furnishes steam for power, it is often impossible to shut down during the week long enough to put in a new tube, but a taper plug may be driven in each end of the tube any night; then, if these are made with a hole through the center and a rod long enough to pass through both and allow a nut at each end, the plugs may be kept securely in place until permanent repairs are made. Such repairs are not to be encouraged; but, in these days of unusual delays and high production, they help greatly in a pinch, and if well done and the boiler is carefully watched, they can do no harm.

Make Machines Cut Their Costs

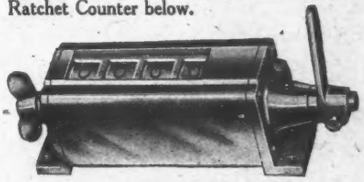
The machine producing its output at lowest cost is the machine you can make most money on—and other things being equal, it's the machine with a *Veeder Counter.*

The counter-equipped machine delivers work at less cost because you can operate it under a production-schedule representing its *best rate-of-work.*

You can watch the out-put under different operating conditions until you develop the *maximum*—then keep to this point of *lowest unit costs* by keeping tab with the

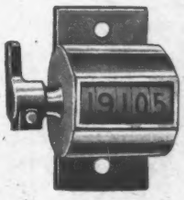
Veeder

For recording and checking-up the output of punch presses, metal-stamping and other machines, where a reciprocating movement counts an operation, manufacturers use the Set-Back Rotary Ratchet Counter below.



Registers one for each throw of the lever, and sets back to zero by turning knob once round. Supplied with from four to ten figure-wheels, as required. Price, with four figure-wheels (as illustrated) $10 (list).

The small Revolution Counter below registers one for a revolution of a shaft, recording a machine operation. The mechanism of this counter will stand a very high rate of speed, making it especially suitable for many types of small machines, and most adaptable for experimental work. Will subtract if run backward. Price, $1.75.



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An Exciting New Game

To be played with a motor and some thread

WITH a small battery motor or a discarded phonograph spring motor, or, for that matter, any other form of motive power on a small scale, it is possible to play a most interesting game.

Aside from the form of motive power on hand, the only other essentials are a long piece of thread of fair strength and a few pieces of paper. The thread is formed into a continuous belt by knotting the free ends together. Part of the belt is passed over some smooth support, such as a chair-arm or a door-knob, which becomes a sort of pulley.

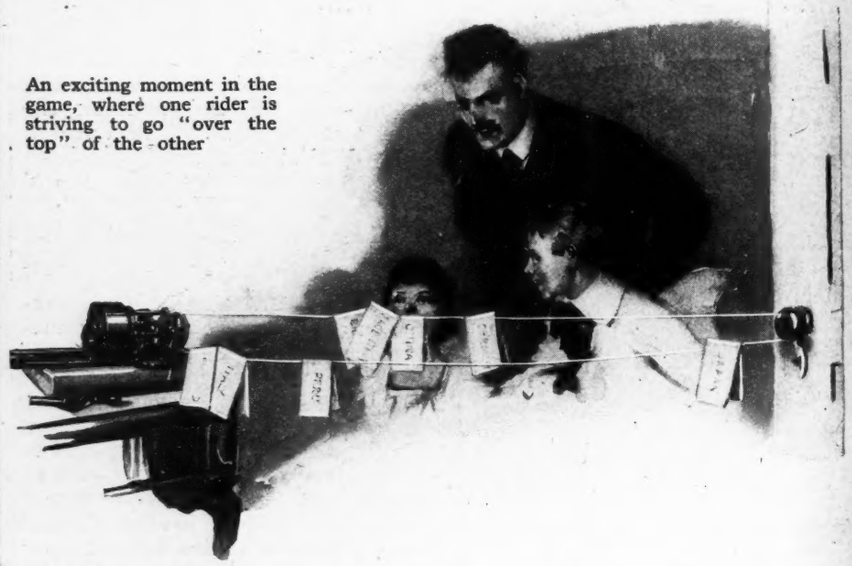
The other end of the belt is wound twice around the pulley of a small motor so as to give it a good hold and keep it from slipping. The belt should be supported between the motor pulley and the support at the opposite end in such a manner that the two strands of thread are parallel and placed about 1 in. apart; then the motor is operated to see that the thread belt moves smoothly over its support and around the pulley.

The next step is to prepare a number of folded strips of paper or "riders," to be placed on the thread as shown in the illustration. If one desires to play a form of war game, these riders are each given the name of some country. They are placed on one thread or the other, according to the side that the rider is to represent.

To start the game, the riders are placed at the ends of the belt, and at the desired moment the motor is started at a slow speed. The riders move toward each other only to engage in the center, and then contest each other's progress. If both sides are of equal strength, the riders push back and forth in a most realistic manner; in fact, it resembles nothing so much as a hotly contested football game, with one side or the other pushing the opponent back to the goal, only to be swept back again to the center of the field. A victory is scored by the side that succeeds in pushing on to the opposite end of the belt.

It sometimes requires half an hour for one side or the other to score a decision. Youngsters and adults will often follow the swaying riders with the same interest that characterizes a football game, especially when each onlooker has picked out one of the riders as his entry. If the players prefer, the riders can be named for various schools or colleges, or given the names of the people who are playing the game.

A similar continuous belt system can be used over considerable distances indoors or outdoors for transmitting dispatches, which can be folded and placed on the thread as riders. If necessary, paper clips can be used in order to hold the riders securely in place.—MIRIAM LESCARBOURA.



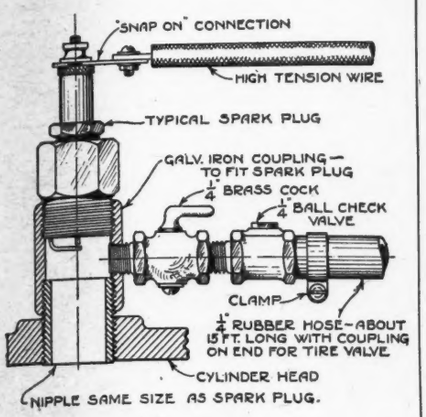
An exciting moment in the game, where one rider is striving to go "over the top" of the other

How to Detect Formaldehyde in Milk

FORMALDEHYDE is often used as a food preservative, especially in milk. The following will furnish a simple test for its detection. Dilute the milk to be tested with about an equal volume of water and add a few drops of a ferric chloride solution. Concentrated sulphuric acid should be carefully poured down the inclined test-tube so that it goes to the bottom, as in the well known brown ring test for nitric acid. The presence of formaldehyde is shown by the appearance of a violet ring where the two layers of liquid are in contact, when the tube is placed in hot water. This test is a very delicate one, for the presence of formaldehyde is shown in two-hundred-thousandth parts of the solution.

A Home-Made Air-Pump for Automobile Tires

INFLATING tires quickly while on the road may be accomplished by the well known method of using one of the engine cylinders as a compressor. To take the place of the spark-plug on one cylinder—preferably the one in the rear—make a connection for the air-hose as follows:


SNAP ON CONNECTION
HIGH TENSION WIRE
TYPICAL SPARK PLUG
GALV. IRON COUPLING—TO FIT SPARK PLUG
¼ BRASS COCK
¼ BALL CHECK VALVE
CLAMP
¼ RUBBER HOSE—ABOUT 15 FT. LONG WITH COUPLING ON END FOR TIRE VALVE
CYLINDER HEAD
NIPPLE SAME SIZE AS SPARK PLUG.

The completed connection from a cross-section view

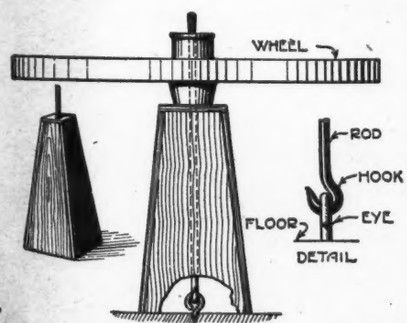
Use a nipple having the same thread as the spark-plug, and on this turn an ordinary pipe coupling. The spark-plug is turned into the upper end of the coupling.

This provides a means of tapping the coupling for a side outlet, into which are fitted a small brass cock, a ball check-valve, and finally the hose connection.

When it becomes necessary to pump a tire, connect the hose with the check-valve to the cock, turn the valve, and let the engine run.—P. P. AVERY.

A Portable Pedestal for the Wheelwright

FOR the sake of economizing space, a wheelwright uses a portable wheel pedestal in his shop. The pedestal is a hollow truncated cone made of boards. An opening in the top



This contrivance may be easily stowed out of the way when not in use

allows an iron rod to project as an axle for wheels. The iron rod hooks to an eye in the floor, thereby anchoring the pedestal.—JAMES M. KANE.

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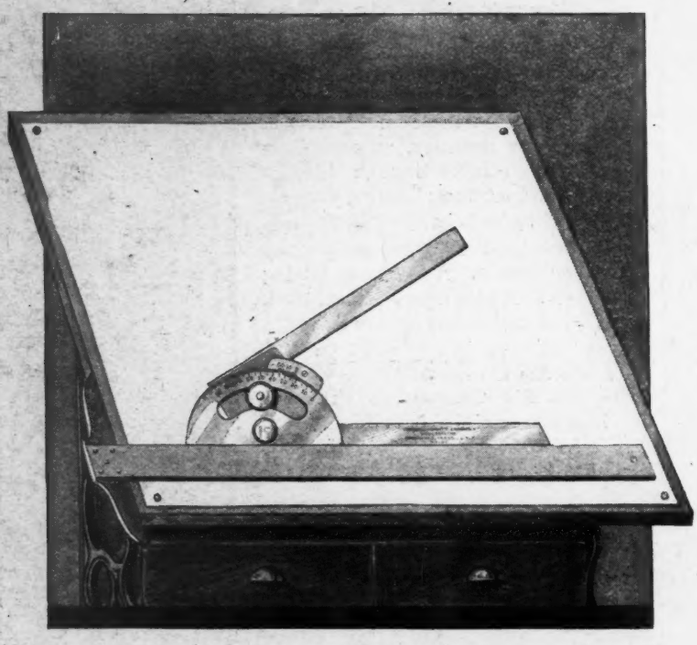

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